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THE NEW COLLEGE OF ENGINEERING OF NORTHWESTERN UNIVERSITY

DEDICATORY ADDRESS

THE beautiful new building which you to-day dedicate calls to my mind in contrast a plain old building at my own alma mater, in which my college work was done. The four walls of that building were as barren of architectural adornment as the cotton mills in the near-by village. And so the building had been known to many generations of students as "The Mill."

But in our minds our college building was a grist mill and not a spinning or weaving mill. Our college was not a place for spinning yarns, but for grinding away at our studies. Grinds, on each other or on our instructors, served to lighten and brighten our tasks. We considered ourselves choice wheat, which the old mill was to turn into the finest flour.

Realizing the associations which cluster in my mind around that old building, you will understand that I intend no disrespect if I liken your beautiful new building to a mill. A new mill, added to a large and prosperous manufacturing plant. A new mill to turn out a new product.

A new product, did I say? No, not a new product, but a staple article. There was a time, it is true, within the memory of men still young, when the engineering graduate was a novelty in the market—a novelty which sometimes found eager purchasers but which at other times literally went begging.

That era long ago passed away. Training men for the engineering profession in colleges is no longer an experiment. The engineering graduate is a staple product.

But even staple products are sometimes a

drug in the market. No man builds a mill to produce even such staples as flour or cotton cloth, without carefully examining market conditions. It is fitting, therefore, that we survey the market conditions for engineers. How stand the relations of demand and supply? What sort of engineers are most needed to-day? What grade of flour will you set your mill to grind?

Perhaps I can best picture to you market conditions in the engineering profession if I draw a parallel between the engineer and one of his favorite materials—Portland cement.

A quarter of a century ago, Portland cement was an expensive and little used article—just like the engineer of a somewhat earlier period. The valuable qualities and many uses of Portland cement were little appreciated when it was first introduced. The pioneer engineers suffered in like manner. To-day fifty huge mills are producing Portland cement where there was one a generation ago. So where there were four small struggling schools of engineering in the United States in 1850, there are to-day more than fifty times that number, and many of these schools number their students by hundreds and even by thousands.

Manifestly these huge mills for making Portland cement would not have been erected if the public had not found a use for their product. So also the engineering schools could not have multiplied in number and grown in size as they have done if the public had not found the engineering graduate a useful and valuable member of society. But I am bound to say to you that enterprise in the erection of Portland cement mills has at times outstripped demand, and as a result the cement market has been overstocked. The market for engineers follows quite closely the market for cement, and during the past two years there have been many idle cement mills and idle engineers.

With both the cement mills and the engineers it has been a case of competition, and survival—if not of the fittest, then of those best able to survive. Undoubtedly the increase in cement mills and in engineering schools has had the effect in each case of lowering the price of the product. But it is also true that this low price combined with excellent quality has enormously increased the demand, both the demand for cement and the demand for engineers.

Is the engineering profession overcrowded? Are its members underpaid? If you submit these questions to a jury of engineers, you will, I am sure, receive an affirmative verdict. But I suspect you would have the same sort of answer if you inquired of lawyers concerning the legal profession or of physicians as to the practise of medicine.

It is a fact, nevertheless, that certain changes in our educational system during the past half century have operated to swell the ranks of the engineering profession above that of other professions, and by the competition thus set up have reduced the compensation of engineers.

Half a century ago college education in the United States meant one thing only—the old-time standard course of studies in the classical languages and mathematics, with a smattering of elementary science and theology. With the rapid progress of science and the industrial arts there came about a powerful reaction against this ancient scholastic drill that had so long passed under the name of a liberal education. The demand arose that the college should teach something practical, something that would make the student better fit for his life-work. The answer to this demand on the part of the colleges was the introduction of a great variety of schools and special courses of study. Of all these schools, the

most popular and the most successful unquestionably have been the schools of engineering.

You will hear men blaming the engineering schools for overcrowding the profession. I do not think we can accept that criticism offhand. I grant you it is true that many more men have been graduated from our engineering schools in the past twenty years than can find employment in engineering work; but would it be well for the profession or for the country to have it otherwise? Must we not frankly recognize that of the men who graduate from our engineering schools every year, a very considerable percentage are not fitted by natural ability to become successful engineers?

I have great sympathy for the many individual cases of hardship that result from the overcrowding of the profession. I freely subscribe to the statement that the engineering profession as a whole is not paid in proportion to the responsibility it carries and the useful service that it renders to the community; and yet I can not believe it for the benefit of engineers or of the public to have the paths into the engineering profession made too easy or the rewards for the lower grades of engineering work too great. The older men in the profession can recall times when there were not enough engineers to meet the demand, when any man who knew how to handle a transit could command a good salary as an engineer. Some of the recruits brought in at such times have been an injury to the profession and to the public. An injury to the profession because the work of incompetent men in any profession injures its reputation and limits its chances for profitable employment. An injury to the public because the public has to stand the loss and the disaster that result from engineering incompetence.

It is not, then, a conclusive argument against increase in engineering schools that the profession is overcrowded. I yield to no man in honoring our profession. The best efforts of my life have been devoted to its advancement; but when the question is squarely put whether there are too many engineers, I am obliged to answer, there are none too many good engineers even though there be a surplus of poor ones. If engineers are underpaid, as I believe they are, it is because the public which employs engineers does not yet appreciate how valuable high-class engineering work is. Somebody has defined the engineer as a man who can do with one dollar what any fool can do with two. When all members of the profession appreciate and act on that definition, the public can well afford to pay princely salaries to its engineers. How many millions of dollars do you suppose might be saved annually in the United States if high-class engineering were substituted for mediocre engineering? Let me give you an example in just one single industry: steam power plants for generating electric current. One of the most prominent engineering firms in this country recently authorized the following statement: If good engineering were used in the design and operation of electric stations in the United States, a saving might easily be made of one fourth cent per horsepower hour, and that would have amounted last year to no less than $37,000,000.

I deprecate that competition in the engineering profession which lowers the pay of engineers. Competition in engineering ought not to be in rate of pay but in quality of service. A few days ago I received a letter from an official board asking what would be a proper salary to pay an engineer for taking charge of a piece of hydraulic construction involving an expenditure of a million dollars. I replied

that the salary they should pay ought to depend on the sort of man they secured. If they engaged a man of exceptional ability he would probably save them so much in the cost of the work that they could well afford to pay him twice or thrice what they would pay an ordinary engineer.

I am not here to indict my own profession. Far from it. But every member of it who has reached mature years, held large responsibilities and come in contact with engineers of all sorts in actual work, will confess that a very large amount of work is done poorly that ought to be done well. That many, many millions of dollars are wasted that might be saved by better design, better supervision, better execution. Engineers, let us confess, are not exempt from the frailties of humanity. Some of us are lazy, and will take the easy course and let things run on in the rut of routine rather than make the effort to prepare new designs to meet changed conditions. Some of us are arrant cowards, and rather than run any risks we will spend money like water—so long as it is not our own money. I have seen engineers of this type take credit to themselves for their conservatism, and prate in official reports about the high-class construction they had secured, when the fact was that they had spent thousands where hundreds would have satisfied every requirement.

I am perfectly well aware that there are men who defend that type of engineering. They claim that an engineer's business is only to look after accuracy, strength, permanence and safety in construction; to use only the best materials and accept nothing but the highest class of work. It is engineers of this type who are responsible for the idea, still too commonly held, that to put an engineer in charge of work means a great increase in its cost. If we had less such engineering, there would be a greater demand for engineers.

I am able to give you a personal illustration of the difference between the two types of engineering. Within forty-eight hours I have talked with men in Washington who know of the work your director has done there in a great government department of engineering work. He had the good sense to see that this work was only a means to an end, and that accuracy and hair-splitting refinement were only valuable where they were effective in the final result. He solved the problem, "What is worth while," and his solution has saved to the government tens of thousands and probably hundreds of thousands of dollars.

I want to see more engineers who are able to wisely solve this problem, "What is worth while," in a hundred lines of engineering work.

How many hundreds of millions of dollars do you suppose are expended annually in the United States in the promotion of foolish and absurd inventions or enterprises wrongly planned? It has long been a theory of mine that people ought to be saved from losing their money in such schemes by seeking the advice of engineers. But I have found that before my theory can be put into practise, we must have engineers who are wise enough and broad enough to give reliable advice on such matters. And the public must learn to discriminate between the engineers who know and those who only think they know.

I think it well to set forth these facts here for the encouragement of those who may be looking forward to the profession and who may have the feeling that engineering work has already reached such a stage of perfection that there is no room in it for further advancement or greater achievements. There *is* room and need today for better engineers and for a higher grade of engineering work.

And so your mill, although it is to grind out a staple product, is not designed to

undersell the market. You are not aiming merely to increase the output of engineering graduates. Your president has clearly emphasized in his address that it is not cheap engineers but better engineering that the public needs.

Magnificent work has been done for the engineering profession by our colleges. I believe our American system of training men for the engineering profession is far in advance of that in vogue in any other country. We must recognize, however, that the rapid changes in science and industry and engineering make changes necessary in our engineering schools. Imagine a boy to-day taking the course of study that was required at the Rensselaer Polytechnic Institute sixty years ago, and then going out to do engineering work. A high-school graduate of 1909 would be in many ways better equipped.

Go back only a quarter of a century and you will find that the engineering courses then in vogue would not suit present-day requirements. It is no argument for those courses that men who graduated from them have achieved eminence in the profession. Many men who were denied all educational advantages have become great by sheer ability.

So we face the question, What education shall the engineering college give to its students to-day that shall best fit them to win success in their profession?

I have called your institution a mill which is to turn raw material into a finished product. Well, it is raw, sure enough, but let us remember that the material is alive—and let us hope very much alive. I believe, after all, your college is not a mill, but—begging the pardon of the freshman class—a greenhouse.

Engineering education, like any other education worthy of the name, is a process of growth. To achieve success in your greenhouse culture you must have the right sort of plants to start with. Unless a boy has natural abilities of the right sort you can not make him into a good engineer.

On the other hand, boys with good natural abilities who can not afford a college training are going out into the working world all the time, beginning at the bottom rung of the ladder in some line of engineering industry, educating themselves in the school of daily experience, aiding that development by study in night schools and correspondence schools and by wide reading and observation.

I want to leave a wide door open into the engineering profession for the men who obtain their education in such a way. I want to deprecate any petty prejudice on the part of college-trained engineers against the engineers who have won success despite their lack of systematic college training. Such prejudice is as unworthy as that with which the so-called "practical" man met the engineering graduates of a quarter century ago.

The engineering colleges to-day must recognize the aids that are now available to the boys outside of the college, in the shape of the correspondence schools, for example. The question is, How shall the boy who spends four years or five years in the college achieve such growth that he can excel in competition the boy who has meanwhile been learning engineering by doing practical work.

For the past twenty years, the engineering colleges of the United States have been trying to answer this question by specializing their instruction in engineering, by multiplying the number of their courses, by trying to make men expert in one particular limited branch of engineering work. Now I am far from denying that there is a large demand and a certain field of usefulness for such special courses; but I believe the consensus of opinion among those best able to judge is that there has been too

much specialization in our engineering instruction. We have to-day in the engineering profession many specialists, but too few men with broad knowledge, broad abilities and a broad outlook.

One common defect in your self-taught engineer is that, however proficient he may be in the one field where he has had experience, he knows little outside that field. It is the lot of most engineers to change their occupation many times in the course of a lifetime. One branch of engineering work falls off and they are obliged to turn to another. It is the advantage of the man with the broad college training that he can do this with facility. The specialist, however, when work in his specialty fails, finds his occupation gone.

Perhaps the error which is most to blame for the specialization in our college courses is the error that the college education in engineering produces an engineer. The engineering graduate when he leaves the college halls is not yet an engineer, and would not be one even if you doubled the length of your course. There are indeed exceptions. An occasional young man of great ability and with a practical bent of mind will get enough out of his college course, supplemented by wide reading and vacation work, to be fit for considerable responsibility at graduation. But such exceptions only prove the rule. The college course in engineering is only laying a foundation on which the finished superstructure is to be erected through accumulated experience in actual work.

Now it may seem to some of you students a little disappointing to spend four or five valuable years and then only succeed in laying the foundation to become an engineer. But I want to assure you that it is in this very matter of foundation that the college-trained engineer has an advantage over his professional brother who "picks up" engineering. With a broad and deep foundation, there is no limit to the size of your superstructure and no limit to the speed with which you may erect it.

But the boy who starts in at engineering work when he leaves the common school is like one erecting a building and putting the foundation under it as he goes along. The job is not impossible, given patience and perseverance enough, but it takes a lot of both. Progress is slow, and the chances are that the man will be satisfied finally with a modest structure. Besides, foundations put in in this way are never quite as strong, never quite as reliable, as those built in the regular way. Sometimes such foundations fail and down comes the building.

The business of the engineering college, then, is to lay a broad, secure foundation. I am not objecting, mark you, to schools of a different sort. There is room and need for correspondence schools, for night schools, for industrial schools, for schools that may give special instruction in special fields. But if you aim to give an education to young men that will best fit them for high and responsible positions in the engineering world, then you must make your training a broad foundation.

And let me carry the simile one step further. You will find great difficulty in laying a secure foundation in a deep swamp or in fathomless quicksand. It will be a far better foundation if underlaid by rock or hardpan. So if you want to build a good foundation of engineering education, you must have to start with a boy of proper mental and moral and physical make-up. Now how will you restrict your work to such boys? That is, I think, one of the most difficult problems which our American colleges have to solve.

They are trying to solve this problem by raising their entrance requirements. They are trying to solve the other problem, how they may send out only high-class men into

the profession, by increasing the work of the college course. These are probably necessary changes; and yet I want to sound one note of warning:

There is danger, I believe—and I am not alone in this belief—that you may shut out of your engineering courses boys who have natural abilities which fit them for success as engineers and yet are deficient in some branch of study, perhaps mathematics or the languages.

I do not underestimate the value to an engineer of either of these branches; yet I feel that they have been often overestimated in the framing of our engineering courses.

There is danger, if you place your emphasis too much on purely scholastic attainments in your engineering schools, that you may raise up a generation of scholastic engineers, expert in theory but weak in its practical application. The mathematical side of the profession and even the research laboratory have been, if anything, overdone already. We must lay broader foundations than these typify if your graduate is to successfully compete with his rival, educated in the school of hard knocks. A broader training than this is needed if your engineer graduates are to meet the demands of this twentieth century.

Do you say, what are these demands? I want to impress upon you that the country to-day needs engineers of high type as it never has needed them before. Few realize the enormous change that has taken place in the relations between the engineer and the public. Go back less than a century—no longer ago than the lifetime of men still living—and you find the engineer almost unknown. Civilization and industry knew his prototype—the millwright, the builder, the miner; but their art was the art handed down by tradition, crusted over with superstition and error. The application of science and the scientific method to industry had barely begun.

Go back half a century and we have the beginnings of engineering: the railway, the steamship, the development of the mine and the waterfall. There were great men among the engineers of those pioneer days. We do well to honor their achievements. Yet the problems of that day, seen in our present light, were simple. The engineer was a necessity in very few industries. His art was not yet so complicated that it could not be mastered by the diligent student with little aid in the way of text-book or teacher.

But the period since the civil war, and particularly the latter half of that period, have seen social, economic and industrial revolutions, such as the world has never before witnessed. Civilization finds itself face to face with a multitude of perplexing problems. And a very large number of these problems are so interwoven with our industrial development that the engineer is needed to aid in their solution.

I have told you that engineers are needed to effectually solve the problem, "What is worth while." Is it worth while to spend two hundred million dollars to build one kind of lock canal at Panama, or three hundred million dollars to build the one we are now completing, or five or six hundred millions to build a sea-level canal? Is it worth while for the government to spend half a billion dollars on waterway improvements? Is it worth while for a state to spend a million or ten millions on good roads? How much ought a city to spend on sewage disposal, on the purification of its water supply, on lighting its streets?

I know engineers who shirk these questions, who say that the engineer should take a humble back seat while the statesman, the lawyer, and—if you please—the ward alderman decide these questions.

I tell you, gentlemen, this is a huge mis-

take. Our statesmen and lawyers and aldermen—even when they are honest and well-meaning—are sadly lacking in knowledge, except it be that little knowledge which is proverbially so dangerous.

For lack of wise engineering leadership the public is being led to-day toward many an unwise and wasteful expenditure. Men are going up and down the land to-day fostering fallacies and errors—errors which will directly affect our national welfare unless good sense and good judgment can be invoked to correct them.

No student of history can fail to be impressed with the importance to a people of able leaders. The prosperity of our own favored nation rests no more certainly on natural resources and on an intelligent and law-abiding people than it rests on wise leadership. The opportunity for leadership is open to the engineer. His technical knowledge is essential to the wise solution of public problems. Can he couple with his technical knowledge those other qualities which are essential if the public is to be safely guided?

And what are some of the qualities? Well, I would name first of all what I may term the judicial spirit. An engineer has no business to be governed by prejudice or partisanship. His sole object ought to be to find where the truth lies. He must constantly make choices in his daily work, and sound judgment in such choices is a first requisite. Of course he must have the knowledge on which to base a judgment; and yet when I am asked to recommend an engineer for large responsibilities, I look first of all for a man of broad mind, one who is able to weigh matters fairly and judge without prejudice. Even though such a man be compelled to rely on others for some part of the technical knowledge required, he is a safer counselor by far than a man of small caliber, though the latter be loaded to the muzzle with facts and theories.

The public has some reason for distrusting the judgment of so-called experts. If your expert has been a man of one idea too long, there is danger that his grasp of broad principles may be deficient and that his judgment may be warped.

Can you develop in your students who go out from this institution those qualities of mind and heart and character which will in later years ripen into sound judgment? If they gain such development from their college training they will gain something much more rare and valuable than knowledge of hydraulics or expertness in the testing laboratory.

Does it seem to you impossible to cultivate in your college course such personal qualities as the judicial spirit? I grant you that a proper mental equipment in the student is essential at the start; but given that, ought not the college years—the formative period of a man's life—to be effective in cultivating just such qualities? Do not our American colleges and universities miss their highest opportunity if they fail to develop in their students a broad outlook, fair-mindedness, keenness to discern error, love of the truth?

I have emphasized the need of engineering leadership. But the essential to leadership is the ability to deal with men. Your engineer may be a master of professional knowledge. He may have even the good judgment necessary for its application; but if he can not meet men face to face and hold his own with them, his professional ability will not win him the highest success.

Every engineer of long experience knows that the ability to write a clear report or a strong letter, to speak forcibly and convincingly, either to one man alone or an audience of hundreds—ability to do things like these is as valuable to an engineer as technical knowledge. Training in writing and in speaking is being emphasized more and more in our engineering courses.

And there are other qualities that make for leadership: tact—the combination of good judgment with good taste in dealing with others; self-confidence without self-conceit; a personality that attracts men, wins their confidence, holds their loyalty. It is qualities such as these that make the leader of men. It is such choice qualities as these that the atmosphere of our universities ought to develop in their students. Was it not with such high ends in view that our universities were founded?

Your splendid new building has higher purposes than a mere mill. You will not rate its success in dollars and cents of annual profit. And I want to protest against the too common standard by which we rate the success of men. You tell me that this graduate holds a $25,000 position, that another owns a rich copper mine and a third is president of a colossal trust. Have they achieved success? Very likely; but why not apply to them the same standard that we apply to your university?

The true measure of success, alike for the university and for its graduates, is the test of public service.

I know an engineer who has through long years guided the destinies of a great city, saved to its taxpayers untold millions of dollars, fostered its development in a way that will benefit generations yet unborn.

I know an engineer who dared to risk his professional reputation and his life to uncover fraud upon the commonwealth and to punish the guilty.

I know an engineer who has turned a barren desert into fruitful farms, has made possible prosperity and happiness to thousands and tens of thousands.

It is true that the public seldom appreciates the value of such services as these, and those who render such service often receive only meager reward; and yet I tell you that it is achievements like these that best deserve the name of success.

Shall we not then dedicate your new building to the culture of such high ideals? Within its walls may all noble traditions, all honorable standards, be fostered and upheld. May those who go forth from its influences carry with them a rich spirit of loyalty—loyalty to the public welfare, loyalty to their city, their commonwealth, their country. So will they justify those who to-day dedicate this building to public service.

CHARLES WHITING BAKER

THE NEW COLLEGE OF ENGINEERING, AN OPPORTUNITY[1]

A GREAT opportunity is before us. Through the generosity of Mrs. G. F. Swift and Mr. Edward F. Swift an excellent building for the new College of Engineering has been erected and its maintenance provided for. The board of trustees has determined to furnish the necessary funds to develop the new college. It will start with all the advantages, and they are many and not easily measured, of being a new department of an old and prosperous university, rather than a new, separate organization. Those persons at Northwestern who have fostered for years the idea that engineering should be taught at this university have had high ideals for the new college which have already helped it. The position of the new College of Engineering, within easy reach of one of the greatest centers of commerce and industry in the world, will furnish its students and professors unusual opportunities to keep in touch with the practising engineer. The new College of Engineering is being started at a time when the methods of engineering education are rapidly changing and developing. This is, therefore, an opportune time for it, if properly guided, to take and

[1] Address delivered at the dedication of the new College of Engineering of Northwestern University by the director-elect.

to hold one of the leading positions in the progress of engineering education. It is much easier for a new organization to develop along new lines than for an old organization to learn new ways.

In order to utilize well this great opportunity it is important that we should have a reasonably well-defined ideal toward which to strive. The ideal should be one from which effective working plans may be developed. To work without an ideal is to invite disaster from the changing currents of general tendencies and of personal opinions, and the strong deep currents of prejudice, or to invite disaster upon the shallows of undirected effort. To choose too high an ideal, one toward which we can not make considerable progress in our approach, is to provide for the formation of working plans which will be ineffective, discouraging to the workers, wasteful of effort and resources.

We might take it as our task to convert the high-school graduates who come to us as freshmen into men who will leave these grounds five or six years later as engineers fully trained and completely equipped mentally for their life work. This ideal can not be even approximately attained. To adopt it would lead to misdirected effort and to wasted opportunities.

Instead, our ideal should be so to train these young men in college that they will be capable of becoming engineers, and will have a tendency to become great engineers. We may hope to make a reasonably close approach to this ideal. We may hope to lay such a foundation of motives, of methods of thought, of principles which have been mastered, and of acquired information, that our graduates may, with accumulated experience and strength acquired by effort, become good engineers ten years after commencement, and in the unusual cases become great engineers within twenty of service.

Having this as our ideal, some of the general features of our working plans will follow naturally.

As it is not our purpose to attempt to graduate fully equipped engineers, we need not attempt to give each student special training in the particular narrow branch of engineering which he expects to follow. We need not attempt to teach the future railway engineer all the minutiæ of that occupation. We need not try to give to the future sanitary engineer all the specific information needed in his chosen line. As our purpose is to equip the graduate for unlimited growth as an engineer, rather than for the greatest immediate usefulness, it is obvious that we should put the emphasis in our teaching strongly upon the fundamentals which are the basis of the specialization in engineering, upon mathematics, chemistry, physics and mechanics.

So, too, in selecting the purely engineering courses which are to be given, each should be examined to ascertain the extent to which it is fundamental, the extent to which it deals with principles of broad application, rather than with principles applicable in a narrow field only, or with mere engineering information. A selection among engineering courses must be made, for it would probably require at least eight years in college for any one student to take all of the different courses now offered to undergraduates in colleges of engineering.

In teaching the broad principles which underlie engineering, in passing to the student that well-organized knowledge contained in the text-books and treatises on engineering which has aptly been called concentrated experience, the college has great advantages over the school of experience. On the other hand, skill, special knowledge and that familiarity with details which is a part, but not all, of experience, may clearly be best obtained outside the college, in the practise of engineering.

These considerations indicate approximately how to make the difficult decisions as to the amount of shop work, laboratory work and drafting which should be put into our curriculum. These courses serve in part one purpose, to illustrate principles, to make them concrete and thereby both to strengthen the grasp of the student upon the principles and to increase his interest in them. These courses, especially if made extensive, also serve another purpose, namely, to develop some skill and judgment in the manipulation of instruments, tools and apparatus. In accordance with our ideal, we should endeavor to stop when the first purpose has been accomplished. To endeavor to accomplish the second purpose also by more shop work, laboratory work and drafting during the college years will necessarily crowd out other courses in lines in which teaching may be done much more effectively in college than out of it.

The student should, however, be encouraged to engage in practical work connected with engineering, during his summer vacations. He may gain from this, in somewhat the same manner as from his first experiences after graduation.

In the statement of our ideal we have acknowledged that the embryo engineer has much to learn after he leaves college and before he becomes a full-fledged engineer. It follows, therefore, that it will be a mistake to keep him too long in college, just as truly as it will be a mistake to turn him out too soon, with too little training. With each year added to his life, the man tends to become less quick to learn new ways, less keen to profit by new experiences. We should not delay unnecessarily the date on which our graduate begins his work in the world. While he is in college he is surrounded by men who are endeavoring to teach him. He has put before him organized knowledge, carefully arranged and carefully presented. As soon as he steps out of college, or at least as soon as he rises above the lowest rank in his profession, the knowledge which it is most important for him to acquire is that which lies outside the field of well-organized knowledge. It comes to him in chaotic fashion. His fellow workers and his official superiors have but little interest in helping him to learn, and have still less activity in that line. With each additional year the young man stays in college, it becomes more difficult for him to adjust himself to this radical change in conditions when he goes out.

For the present, we have adopted a five-year course for engineers. Past experience in colleges of engineering shows that a four years' course is too short. The considerations just touched upon should lead us to examine with care any other considerations which seem to indicate that the course should be extended to six years.

The adopted five-year course for engineers is so arranged and provides for such liberal training that at the end of the first four years the successful student will have fulfilled all the requirements for, and will receive, the degree of bachelor of science from the College of Liberal Arts. An engineering degree will be granted at the end of the fifth year.

We have adopted as our ideal the proposition that we are to train engineers for the greatest average effectiveness in the first year after graduation. We should, therefore, avoid sending out our graduates handicapped by ignorance of men. The young engineer, or the old unsuccessful engineer, so long as he remains in such a minor position that he has no official subordinates and never needs to take the initiative, is but little handicapped by ignorance of men. But as soon as he begins to rise, and in proportion to the extent to which he must necessarily depend on those below him for details and for loyalty, on those around him for cooperation, and must

be trusted by those above, his progress is dependent upon knowledge of men. Cases are not infrequent in the engineering world in which the upward progress of an engineer is absolutely stopped by his clumsiness in dealing with men, even though he has great skill in dealing with materials and forces. It is our duty to teach our future engineers not only about forces and materials, but also about man and his ways, to bring it before them with emphasis that their future success in utilizing their engineering knowledge and skill depends upon their ability to work with men, among men and through men.

In the College of Engineering we may expect certain difficult problems to be ever present, intertwined with a multitude of other problems. The success of the college depends largely upon our success in solving these problems which are easily overlooked and neglected because of their familiarity. I intend to suggest but three examples.

Language is one of the important tools of an engineer. He must ordinarily do his work through others. He must have the power to convince. He must have the ability to use English accurately and effectively or be handicapped even in his strictly engineering work. One who acquires the ability to speak and write accurately and well, usually secures with it the power to think accurately. How can we best help the student in his college days to acquire the ability to speak and write well? This is a problem common to all colleges and to all universities. To one who deals much with recent graduates, it is discouragingly evident that but mediocre success has been attained in universities in solving this difficult problem.

It is a comparatively easy matter to lead a student along a given line of thought, but how can the student be trained to think for himself? That is one of the exceedingly difficult problems which confront us in the College of Engineering in common with all parts of the university.

We should aim, in the College of Engineering, to give our students a broad training, yet we desire to give them thorough training along certain lines. How is the broadening to be secured? Is it to be gained from certain courses intended for that especial purpose, or is it to be secured by the manner of teaching each course, even technical courses? This, again, is a problem common to nearly all, if not all, parts of the university.

The real success of the College of Engineering is dependent upon the solution of ever-present problems of which these are but examples. Because of the existence of numerous problems of this character which are common to the whole university, the College of Engineering gains strength from being a part of Northwestern University, rather than a separate institution. Because the engineer has a peculiar point of view, and the courses in engineering have some special advantages in connection with certain of these universal problems, the College of Engineering may hope in time to contribute a share toward the solution of these problems in this university.

Let us adopt as the motto of the College of Engineering the words, "Culture for usefulness." Let us put the emphasis strongly on the last two words. The first word alone may lead one astray, but the three together are a sure guide. The attempt to gain culture for the purpose of increasing one's usefulness in the world is essentially unselfish. In setting this motto before our students and in thus suggesting that they are to seek culture, not primarily for themselves, but in order to increase their usefulness in the world, usefulness of the broadest kind in the great united struggle of man for progress, we shall be setting before them an ideal which includes all others, an ideal which urges one

to the broadest attainable culture, in college and afterwards, an ideal which is inspiring and invigorating to any one who realizes its meaning.

We are here to-day to dedicate a building to engineering education. In a deeper and better sense, we are here to dedicate ourselves to the highest and best use of the great opportunity which the building represents, an opportunity to give an uplift to the ideals and to increase the usefulness of thousands of young men who are to enter their life work through that building, an opportunity to help in raising the standard of engineering education, an opportunity to help in making American universities of greatest real service to American people.

JOHN F. HAYFORD
NORTHWESTERN UNIVERSITY

COMPARATIVE ENROLMENT OF STUDENTS OF ENGINEERING

IT is generally supposed that the attendance on the engineering schools of our country continues to show the rapid gains that have marked their development during the past ten or fifteen years, and while at the majority of the institutions the enrolment of to-day compared with that of say five years ago would exhibit a healthy increase, an analysis of the accompanying table proves that a reaction is apparently beginning to set in, at least at a number of the institutions. It will be seen from the table that the present total attendance of engineering students at twenty-four representative institutions shows an increase over last year of only one hundred and ninety-one students, or one of 1.15 per cent. The figures given include students of engineering, mining and metallurgy, and chemistry, but are exclusive of students of architecture (with one or two exceptions), agriculture, forestry, biology, etc. It should be noted that a number of institutions (for example, the Massachusetts Institute of Technology) have one or more of these last mentioned courses, and that the figures in the table do not, therefore, represent in every case the *total* registration of the school. In some instances (for example, Michigan) graduate students are included, in others (for example, Columbia) they are not; most of the institutions submitted the spring registration, but in a few cases the fall figures are given, and there may be several other minor differences, yet in spite of these discrepancies, the table as given will convey a sufficiently accurate idea of the most recent changes in engineering attendance. Owing to the regulation requiring a baccalaureate degree for admission to the school of applied science, which has recently become operative at Harvard, the figures of this institution have been omitted, since a comparison would be somewhat misleading. Thirteen of the institutions exhibit a gain in attendance over last year, while eleven show a loss. It is interesting to note that of the independent schools six show losses in attendance as compared with last year, whereas only five of the schools connected with universities have experienced a decrease in enrolment since 1907–8, while eight schools connected with universities and five independent schools show gains.

Institution	Registration		Increase or Decrease	
	1907–08	1908–09	No. of Students	Percentage
Cornell University	1,638	1,727	89	5.4
Purdue University	1,398	1,364	—34	— 2.4
University of Michigan	1,345	1,335	10	0.7
Massachusetts Institute of Technology	1,259	1 297	38	3.0
University of Illinois	1,059	1,081	22	2.1
University of Wisconsin	940	906	—34	— 3.6
Ohio State University	839	888	49	5.8
University of California	794	818	24	3.0
Yale University (Sheffield Scientific School)	788	793	5	0.6
Columbia University	618	717	99	16.0
University of Minnesota	647	677	30	4.6
Rensselaer Polytechnic Institute	609	660	51	8.4
Lehigh University	662	646	—16	— 2.4
Armour Institute	521	518	— 3	— 0.6
Worcester Polytechnic Institute	462	487	25	5.4
University of Missouri	466	444	—22	— 4.7
Case School of Applied Science	479	431	—48	—10.0
University of Nebraska	439	396	—43	— 9.8
Stevens Institute of Technology	435	390	—45	—10.3
Colorado School of Mines	349	380	31	8.9
Michigan College of Mines	266	277	11	4.1
University of Iowa	239	218	—21	— 8.8
Rose Polytechnic Institute	223	206	—17	— 7.6
Tulane University	145	135	—10	— 6.9
Total	16,600	16,791	191	1.15

RUDOLF TOMBO, JR.

SCIENTIFIC NOTES AND NEWS

By unanimous vote of its council the American Psychological Association will hold its next meeting in Boston in affiliation with the American Association for the Advancement of Science.

At the colloquium of the American Mathematical Society, to be held at Princeton University, September 15–17, courses of lectures will be delivered by Professor G. A. Bliss, on "Fundamental Existence Theorems," and Professor Edward Kasner on "Geometric Aspects of Dynamics." Professor J. H. Jeans having resigned his position at Princeton, the course of lectures announced to be given by him has been cancelled.

In connection with the Darwin centenary, at Cambridge, it is proposed to confer the degree of doctor of science upon E. van Beneden, professor of zoology in the University of Liège; Robert Chodat, professor of botany in the University of Geneva; Francis Darwin, F.R.S., of Christ's College; Karl F. von Goebel, professor of botany in the University of Munich; L. von Graff, professor of zoology in the University of Gratz; H. Höffding, professor of philosophy in the University of Copenhagen; J. Loeb, professor of physiology in the University of California; E. Perrier, director of the Natural History Museum, Paris; G. A. Schwalbe, professor of anatomy in the University of Strassburg; H. von Vöchting, professor of botany in the University of Tübingen; H. de Vries, professor of botany in the University of Amsterdam; C. D. Walcott, secretary of the Smithsonian Institution; E. B. Wilson, professor of zoology in Columbia University, and C. R. Zeiller, professor of paleobotany in the École Nationale Supérieure des Mines, Paris.

Mr. Phillip Fox, of the Yerkes Observatory, has been nominated by the Chicago Astronomical Society, to be director of the Dearborn Observatory and professor of astronomy in Northwestern University in succession to the late Professor Hough.

Professor C. H. Eigenmann, professor of zoology and dean of the Graduate School of the Indiana State University, has been appointed curator of ichthyology at the Carnegie Museum, Pittsburgh, with the understanding that his appointment will not interfere with his duties in connection with the Indiana State University. Professor Eigenmann will work up the large collections belonging to the museum at his home in Indiana, and will during the summer months devote a portion of his vacation to directing others in arranging the collections systematically.

Dr. Victor Sterki, of New Philadelphia, Ohio, known for his work on the North American *Pupidæ* and allied families, has been appointed an assistant in conchology at the Carnegie Museum. Dr. Sterki's collection became the property of the museum some years ago.

Mr. E. Dana Durand, deputy commissioner of corporations, has been appointed director of the Census to succeed Mr. S. N. D. North.

Professor Simon Newcomb has left the Johns Hopkins Hospital and returned to his home in Washington.

Professor Dünkelberg, formerly director of the Agricultural Academy at Poppelsdorf, has celebrated his ninetieth birthday.

In addition to the list of delegates to the Darwin celebration of Cambridge University, printed in a recent issue of Science, the National Academy of Sciences will be represented by Dr. George E. Hale, of the Mount Wilson Solar Observatory, and the Massachusetts Institute of Technology by Professor William T. Sedgwick.

Mr. S. F. Emmons, of the U. S. Geological Survey, has been appointed a delegate to represent the National Academy of Sciences at the five hundredth anniversary of the foundation of Leipzig University, which will be celebrated on July 28 to 30, 1909.

Mr. W. Bateson, F.R.S., will give the Huxley lecture at Birmingham this year.

Mr. C. G. Abbot, director of the Smithsonian Astrophysical Observatory, has left Washington for Mt. Wilson, California, to continue there during the summer and fall observations in progress for a number of years as to the intensity of the sun's rays and the effect of any variation in them upon the earth.

There has recently been erected on Mt. Wilson a small permanent observatory especially designed for this purpose. Here Mr. Abbot, with the assistance of Dr. L. R. Ingersoll, of the University of Wisconsin, will study during the next few months. The expedition will also spend some time on the summit of Mt. Whitney, 14,500 feet high, where the Institution plans to erect in July a shelter of stone and steel for the use of scientific investigators engaged in researches of any kind for which high altitudes, dry air and clear skies are desirable.

RALPH S. TARR, of Cornell University, will spend the summer in making a further study of the glaciers of Alaska. He will be accompanied by Professor Lawrence Martin, of the University of Wisconsin.

PROFESSOR OTTO NORDENSKJIOLD and Dr. Hilmar Skoog will this summer conduct explorations in Greenland.

DR. ALEXANDER PETRUNKEVITCH, honorary curator of arachnida in the American Museum of Natural History, will spend July and August collecting arachnida and other forms of insect life in Texas, Mexico and Guatemala.

PROFESSOR J. HORACE FAULL, of the University of Toronto, has been granted leave of absence for the academic year 1909–10. He is continuing his studies on the cytology of the Ascomycetes, particularly of the Laboulbeniaceae at the Laboratories of Cryptogamic Botany, Harvard University.

SUPERINTENDENT GEORGE MCKERROW, of the department of farmers' institutes in the College of Agriculture, University of Wisconsin, has sailed for England to attend the annual meeting of the British National Sheep Breeders' Societies, held in connection with the Royal Stock Show, June 21, at Gloucester, England. Mr. McKerrow, will deliver the annual address on "How We Can Improve the Sheep Industry."

A PORTRAIT of the late Carroll D. Wright, president of Clark College, has been presented to the college, and will be unveiled at the memorial services to be held on July 14. The speakers will include President G. Stanley Hall for the university and Dean Rufus J. Bentley for the college.

DR. G. A. GIBSON, of Edinburgh, has undertaken to edit the medical and scientific papers and articles of the late Sir William Tennant Gairdner, and to preface the volume with a biography.

A MONUMENT in honor of Michel Servetus will be unveiled at Vienna in the department of Isère on August 14. Professor J. C. Hemmeter, of Baltimore, will make one of the addresses.

M. J. IORNS, Ph.D. (Cornell), who has been for several years horticulturist of the Porto Rico Experiment Station at Mayaguez, died of typhoid fever in San Juan on May 17.

DR. CHARLES BURNHAM PORTER, formerly professor of clinical surgery at Harvard Medical School, died on May 21 at the age of sixty-nine years.

DR. WILLIAM WIGHTMAN, of the Public Health and Marine Hospital Service, died at Guayaquil, Ecuador, on May 17, from yellow fever.

MR. GEORGE C. EDSON, of St. Alban's, Vermont, known for his work on the geology of the state, died on May 24.

DR. BINDON BLOOD STONEY, F.R.S., a distinguished Irish engineer, died at Dublin, on May 5, in his eighty-first year.

M. JULES ERNEST NAVILLE, formerly professor of philosophy in the University of Geneva, died on May 27, at the age of ninety-two years.

DR. HEINRICH VON RANKE, professor of diseases of children at the University of Munich and known also for his work on hygiene, agriculture and archeology, has died at the age of seventy-nine years. Professor Johannes Ranke, the eminent anthropologist and physiologist, of the University of Munich, is his brother, and Leopold von Ranke, the historian, was his uncle.

THE deaths are also announced of Dr. Oskar Emil, emeritus professor of physics at Breslau, at the age of seventy-four years; of Dr. Hermann von Stahl, professor of mathematics at Tübingen, at the age of fifty-six years; of Dr. Alfred Partheil, professor of pharmaceutical chemistry of Königsberg, aged forty-eight years, and of Dr. Otto Biermann, pro-

fessor of mathematics at Brünn, at the age of fifty-one years.

The seventh International Congress of Applied Chemistry opened in London on May 27, with some three thousand members in attendance. At the opening exercises Dr. Harvey W. Wiley, of the U. S. Department of Agriculture, replied for the United States.

The ninety-second annual meeting of the Société helvétique des sciences naturelles will be held at Lausanne on September 5–8, under the presidency of M. Henri Blanc.

The annual congress of the Southeastern Union of Scientific Societies will be held at Winchester on June 9–12, under the presidency of Dr. Dukinfield H. Scott, F.R.S.

At the National Conference on Criminal Law and Criminology held in celebration of the fiftieth anniversary of the Northwestern University School of Law at Chicago from June 7–9, the Honorable Charles S. Deneen, governor of Illinois, has consented to act as temporary chairman. In order to facilitate organization, the committee of organization will nominate (with his consent) for permanent chairman, James Hagerman, Esq., of St. Louis, sometime president of the American Bar Association. The committee will also nominate for temporary chairman of the Section on Treatment (Penal and Remedial) of Offenders, Dr. E. T. Devine, professor of social economy in Columbia University, New York; for temporary chairman of the Section on Organization, Appointment and Training of Officials, Dr. Edward A. Ross, professor of sociology in the University of Wisconsin, Madison, Wisconsin; for temporary chairman of the Section on Criminal Law and Procedure, William E. Mikell, Esq., professor of law in the University of Pennsylvania, Philadelphia.

The Chicago Chapter of the Sigma Xi Society held its biennial election of officers on May 25, 1909, which resulted as follows: *President,* E. H. Moore; *Vice-president,* R. R. Bensley; *Secretary and Treasurer,* Oscar Riddle; *Corresponding Secretary and Councilor,* Julius Stieglitz. The paper of the evening was presented by Mr. Bailey Willis, U. S. Geological Survey, upon "China, the Land and the People."

The Iota Chapter of the Alpha Chi Sigma Chemical Fraternity was installed at Rose Polytechnic Institute on May 22 by Mr. L. S. Palmer, of the University of Missouri; Dr. J. H. Mathews, of the University of Wisconsin, and Mr. O. C. Stanger, of the University of Illinois. The following men constitute the active members of the new chapter: H. J. Bangert, H. Isenberg, R. S. Wilson, J. V. Davidson, R. L. Flood, F. W. Kroemer, Jr., F. Cohen, J. A. Hepp and D. M. Hubbard. Dr. Carl Leo Mees, president of the institute, and Dr. John White, professor of chemistry, were made honorary members. A banquet followed the installation.

The launching of the Magnetic Survey yacht *Carnegie* will take place on June 12, 1909, 2:30 P.M., at the Tebo Yacht Basin Company, foot of 23d Street, Brooklyn, N. Y. Miss Dorothea Louise Bauer, daughter of Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism, has been chosen by the executive committee of the Carnegie Institution of Washington to perform the christening ceremony.

In order to put a stop to the serious damage done by persons uprooting ferns and wild plants growing in hedgerows and on commons, etc., in the county of Surrey, England, the Surrey County Council has made the following by-law: "No person shall uproot or destroy any ferns or other wild plants growing in any road, lane, roadside waste, wayside bank, or hedge, common, or other public place, in such a manner or in such quantities as to damage or disfigure such road, lane, or other place. Provided that this by-law shall not apply to persons collecting specimens in small quantities for private or scientific use. A person offending against this by-law shall be liable to a penalty not exceeding £5."

UNIVERSITY AND EDUCATIONAL NEWS

Mr. W. C. Proctor, of Cincinnati, of the class of '83, has offered to give Princeton University $500,000 for its graduate school on condition that an equal sum be subscribed within a year.

THE legislature of Pennsylvania at its last session appropriated three hundred and twenty-five thousand dollars to the University of Pittsburgh to be expended for new buildings and maintenance.

BY the late Dr. F. W. Draper, Harvard University receives an unrestricted bequest which it is believed will amount to $100,000.

THE Massachusetts legislature has appropriated $80,000 for the erection of a fireproof building for the departments of zoology and entomology, at the Massachusetts Agricultural College.

THE New York legislature appropriated $57,000 for the use of the Agricultural School of St. Lawrence University.

THE Tennessee legislature has passed a bill giving 25 per cent. of the state's revenues for education, 7 per cent. being for the university and experiment station.

THE late Mr. James Duncan has bequeathed a portion of his estate, calculated to amount to about $300,000 for the establishment of a school of industrial art in Dundee, Scotland.

THE new Institute of Physiology at University College, London, will be formally opened on Friday, June 18, by the Hon. R. B. Haldane, secretary of state for war. The funds for the building of the institute were provided by Mr. Ludwig Mond and Dr. Aders Plimmer and by a bequest of the late Mr. Thomas Webb.

DR. SAMUEL AVERY, head of the department of chemistry in the University of Nebraska and acting-president since the resignation of Dr. Andrews, has been elected president of the institution.

DR. ERNEST MERRITT, professor of physics, has been appointed dean of the graduate school of Cornell University.

AT the University of Minnesota, Professor John Zeleny has been appointed head of the department of physics to succeed Dean Frederick S. Jones, who has been called to the deanship of Yale College; Assistant Professor Anthony Zeleny has been appointed professor of physics, and Dr. W. F. Holman, of Worcester Polytechnic Institute, instructor in physics; and a new instructorship not yet filled has been created. Assistant Professor H. A. Erikson returns to the department after a year's absence at Cambridge, England, and Dr. A. F. Kovarik has obtained a leave of absence for study abroad.

DR. H. H. HORNE, professor of philosophy at Dartmouth College, has been appointed professor of the history of education at the New York University, to succeed the late Professor Gordy.

DR. CHARLES T. BURNETT, of Bowdoin College, has declined a call to the chair of psychology at Amherst College.

MR. C. T. BRUES, of Milwaukee Public Museum, has been appointed instructor in economic entomology at Harvard University.

MISS MABEL BISHOP, fellow in zoology in Smith College, has been appointed instructor in biological science in the Woman's College of Baltimore.

DR. J. B. LEATHES, of London, has been appointed professor of chemical pathology in the faculty of medicine of the University of Toronto.

DISCUSSION AND CORRESPONDENCE

TO THE PHILOSOPHIC ZOOLOGIST

Whether definite variations are by chance useful, or whether they are purposeful are the contrasting views of modern speculation. The philosophic zoologist of to-day has made his choice. He has chosen *undirected* variations as furnishing the materials for natural selection. It gives him a working hypothesis that calls in no unknown agencies; it accords with what he observes in nature; it promises the largest rewards.

The above paragraph is a quotation from the address of my friend and colleague, Professor T. H. Morgan, delivered in the Darwin course at Columbia University, February 26. It is interesting as showing the absolute divorce between the zoological and paleontological observer, a matter to which I have called renewed attention in my Baltimore address recently published in "Fifty Years of Darwinism."

If the word "undirected" implies fortuity, as I presume it does, it is an interesting future possibility that the theory of the building up

of adaptations out of the natural selection of undirected variations, to use my colleague's language, may prove to be a dogma quite as unsupported by facts as the Lamarckian dogma of the inheritance of acquired characters. I long ago pointed out that a very large number of new characters in the hard parts of mammals are adaptive in direction from the beginning; I am very far from saying that *all* new characters are adaptive in direction; I only make this statement as to those characters I have had the opportunity of repeatedly observing.

I now challenge the zoologists to produce a single instance of a series of animals in which adaptive characters are being accumulated through the *selection* of undirected variations, *i. e.*, of variations which are thoroughly mixed up, in which *there is no law evident.* Such a series has never been produced by any one. Of course I bar from this challenge orthogenic changes of character under environmental influences. I refer to the *pure* Darwinian hypothesis. The hypothesis is still as Darwin left it, an ingenious working theory, awaiting either experimental evidence or evidence of any kind. How long this assumption will pass muster as based on observation it is hard to say. We await some paleontological Weismann who will smite it hip and thigh as the zoological Weismann smote Lamarck's assumption.

While the "philosophic zoologist" of to-day has made his choice, the philosophic paleontologist has also made his choice. The latter certainly does not find direction in the old teleologic sense, but quite as certainly he finds no evidence of such fortuity as will justify the use of the word *undirected* as furnishing materials for natural selection. The materials for natural selection are furnished by the *ensemble* of an enormous number of characters, each of which is a unit pursuing its independent history and fluctuating and mutating and moving in direct lines under laws which the philosophic paleontologist has proof of, but totally fails to understand. Consequently he assumes the agnostic position that there is some principle, or principles of direction, or better—to use Professor Morgan's own words —"unknown agencies," still to be discovered other than the principle of order coming out of fortuity.

Henry Fairfield Osborn

Nelson's Loose Leaf Encyclopedia.

To the Editor of Science: In February an article was published in Nelson's "Loose Leaf Encyclopedia" upon the Messina-Reggio earthquake, the authorship of which was credited to Mr. Frank A. Perret and myself. In justice to Mr. Perret, however, it should be stated that he had nothing whatever to do with the preparation of the article beyond furnishing the one item pertaining to the height of the "tidal" wave at Messina which is duly credited to him. The insertion of Mr. Perret's name as joint author was done by the publishers of the encyclopedia without my knowledge or consent, but thus far I have been unable to obtain any correction of their error.

E. O. Hovey

New York,
May 11, 1909

Scientific Books

General Physics. By Henry Crew. New York, The Macmillan Co. 1908.

A Text-book of Physics. Edited by A. Wilmer Duff. Philadelphia, P. Blakiston's Son & Co. 1908.

The publication of these two excellent text-books designed for college classes in physics illustrates the general dissatisfaction among college professors of physics with both existing text-books and accepted methods. There are many difficulties inherent in the teaching of physics and there are many points concerning which the best teachers are to a certain degree undecided. As physics is taught at the present time in most American colleges the time devoted to it is one year during each week of which there are three hours of lectures or class work, accompanied by five or six hours of laboratory work. In this time a student is supposed to cover the field of elementary mechanics, properties of matter and physics proper, including heat, light, etc. Within recent years a demand has arisen for text-books which should have more or less refer-

ence to the different classes of students following the course, the point being that stuents looking forward to engineering ostensibly need a text-book different in character from that best fitted for other students. The difficulties of satisfying these requirements by any one text-book are insuperable. At the very best the author must make certain compromises and must adapt his book to certain actual conditions, and to the classes with which he is most familiar. It is not an easy matter to prepare a text-book in physics which shall satisfy the obvious pedagogical requirements for physics as a subject in general education and at the same time meet the requirements mentioned above. It is not to be expected that all teachers of physics should feel satisfied with all text-books of physics, from the standpoint either of general purpose or of detail, but the two books under review are certainly admirable in many respects, and are sure to have a well-deserved popularity among American colleges.

The author of the present review is not certain as to the object of such an article. It certainly should not be to point out typographical errors, or even to refer to what may seem to him to be misstatements of facts or of theory. On the contrary, perhaps the best result may be secured by noting both the obvious facts concerning the book and the points by which each differs from other well known books.

Professor Crew's book is a beautiful piece of book-making; the paper, type, wood-cuts and binding are all that could be desired. It contains 515 pages, of which 182 are devoted to mechanics and properties of matter, 64 to wave motion and sound, 61 to heat, 115 to magnetism and electricity and about 100 pages, the rest of the book, to light. The balancing of the various subjects, as shown by this subdivision, is admirable. One would expect that this text-book would prove most satisfactory to any college class; the references to the historical development of the science are most interesting and inspiring; the various machines or experimental facts which are given as illustrations of the general theories are well selected and described with enthusiasm; in fact, the whole book is permeated with a certain charm thoroughly characteristic of all of Professor Crew's own enthusiasm as a teacher and investigator. Another excellent point about the book is the selection of problems. These contain not only useful arithmetical illustrations, but also questions which require the exercise of reasoning as apart from any use of formulæ or numbers. It is only in a few places that the author seems to introduce matter which is too far removed from the elementary character of the general book.

The text-book edited by Professor Duff is a compilation of seven sections prepared by different authors as follows: Mechanics, by Professor Duff himself; Heat, by Professor Guthe; Wave Motion and Sound, by Professor Hallock; Light, by Professor E. P. Lewis; Electricity and Magnetism, by Professor Goodspeed; Electromagnetic Induction, by Professor Carman, and Conduction of Electricity through Gases and Radioactivity, by Professor McClung.

In attempting to prepare a book in this manner there are no unavoidable difficulties provided the general editor is one who has certain executive powers, and certainly in this case the publishers are fortunate in having persuaded a man of Professor Duff's ability to assume the task. As is to be expected in such a compilation, there is a certain degree of inequality, but in this particular illustration it is reduced to a minimum. In fact, the work is admirably done from the standpoint of the general editor. The book contains 666 pages and is divided into the seven sections referred to; 177 being devoted to mechanics and properties of matter, 102 to heat, 45 to wave motion and sound, 143 to light, 154 to electricity and magnetism, including electromagnetic induction, 136 to conductivity of gases, etc. At the end of the various sections there are sets of problems which in the majority of cases are admirably selected. The illustrations are clear, but lack the charm of those of Professor Crew's book; the type and paper are satisfactory, although not so good as to demand special attention.

It is not easy to decide as to the class of students for which this book is designed, be-

cause in some ways the treatment is most elementary and in other chapters use is made of the calculus. The field covered is satisfactory on the whole, as is shown by searching in the various chapters for discussions of all the important general phenomena. It would not be difficult to refer to certain sections which might be omitted with profit, but on the whole there is little to criticize in this respect, for the rights of the individual teacher and author must be respected.

The success of any text-book in physics must be decided from its effect upon the mind of the students who use it. If they are taught by means of it to reason correctly, and if they learn a consistent view of the great phenomena of nature, it has accomplished its purpose. A great deal naturally depends upon the teacher, but certainly in the present case the authors of the text-book referred to above have done their full share. J. S. Ames

The Johns Hopkins University

A Manual of North American Diptera. By Samuel W. Williston. Third edition, illustrated. New Haven, Conn., James T. Hathaway. 1908. Price, $4.00 postpaid. Pp. 405, duodecimo, cloth.

The much-desired third edition of Dr. Williston's manual was actually published and some copies distributed about August 28, 1908, but on account of the absence of the author on a fossil-hunting expedition in western Texas only a few copies were sent out until about the end of the year. It has, therefore, received but little notice in reviews up to the present time.

The book, like the preceding editions, is designed largely for beginners. It contains an introduction, a treatise on the anatomy of diptera, suggestions as to methods of collecting, preserving and studying the insects, some general remarks on the principles of classification, a synoptic table of the families and a series of chapters on the families. These last-mentioned chapters each include one family, giving in uniform style the following topics: definition of the family, characters of the larvæ, habits of larvæ and adults (often at some length), and table of genera based on adult characters. In a few cases the larvæ are to some extent subdivided in a separate table. Several of the chapters are written partly or wholly by other entomologists.

The illustrations form a new and conspicuous feature of the work, numbering nearly a thousand. While recent entomological literature has been drawn upon to some extent, a large proportion of the figures are new and drawn by Williston himself, representing an immense amount of labor on his part.

In the preface, after mentioning the successive publications in which he had attempted to outline the classification of North American diptera, the author states that he feels his work in this line completed with the present publication. Perhaps, for this reason, he has allowed himself to express his views and even his feelings to a greater extent than in former editions. Many passages might well be quoted, either as illustrating generalizations derived from thirty years of strenuous scientific work, or to illuminate points of disagreement between the author and certain younger dipterists. A very few selections must suffice.

Giantism in any group of animals is a specialization, and is, in general, an indication of approaching decadence. . . . No strong or dominant group of flies, like the Tachinidæ, Dolichopodidæ, Syrphidæ or Bombyliidæ, has ever had in the past a larger average bodily size than is found among their living representatives.

On the splitting of genera in the mosquitoes:

I fear even Desvoidy's shade would turn pale with envy in the contemplation of some of the proposed genera of the modern culicidologists.

On the "mere collector":

His labors are hardly more important than those of the microtomist who cuts up frogs' eggs and makes pictures of them.

In the matter of wing nomenclature the common system is wisely adhered to, while the Comstock (here called the Comstock-Needham) is illustrated in a page of wings. Unfortunately, the tabular exhibit of homologous terms is imperfect because Comstock's earlier designations are used. The fact that there are already three distinct forms of Comstock nomenclature in existence is an excellent rea-

son, if any were needed, for not introducing even the latest one into the manual.

In the classification of mosquitoes he expresses strong dissent from the process of continually subdividing the great central mass of the genus *Culex,* but naturally is not in a position to elaborate a system, and is therefore obliged to use one that is not much different from that of Dyar and Knab. In Cecidomyidæ, too, he finds too many genera, and adopts a current generic table only under protest. In Dexiidæ and Tachinidæ the tables were prepared by Professor C. F. Adams. Dr. Williston, wishing the criticism of a specialist on this difficult group, and being unable to secure the assistance of Mr. Coquillett, asked Mr. C. H. T. Townsend to prepare notes on the figures. This was unfortunate, as Mr. Townsend's ideas of genera are extremely radical; it naturally happened that his notes only serve to confuse the subject. He, however, seized the opportunity to erect a few new genera on the figures, which was the more out of place and uncalled for since he promised fuller descriptions in a forthcoming paper. Would that he had reserved his adumbrations in their entirety!

A few errors in typography and other mistakes are corrected in a brief appendix. Typographical or any other sort of perfection must not be demanded in a contribution offered as a gift to science after years of strenuous and wholly gratuitous effort. Professor Williston has acquitted himself well, and has given us a work which no one else in the world could have produced, one not approached in any other large order of North American insects. Nay, he has done still more—he has printed it practically at his own expense, and will not be reimbursed until almost the whole edition is sold. Because I happen to know this I wish the entomological public to understand how great their debt really is. And Professor Williston never occupied an entomological position in his life. He has given *himself* to science, and that is the greatest offering any man can make.

J. M. ALDRICH

MOSCOW, IDAHO

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of *The Journal of Biological Chemistry* (Vol. VI., No. 2, issued May 10, 1909) are as follows: "On the Composition of Dilute Renal Excretions," by A. B. Macallum and C. C. Benson. Large volumes of water were ingested to increase rapidity of flow and decrease concentration of urine in order to diminish the reabsorption of water and salts in the convoluted tubules of the kidney postulated in Ludwig's theory of urine formation. Estimations of potassium and chlorine in very dilute urine revealed neither a proportionality between salt content of blood plasma and of urine nor a uniform ratio of potassium and chlorine excretion. Secretion of water and salts is therefore not a process of filtration, but is truly secretory; the secretory activity varies for each inorganic constituent. "On the Depression of the Freezing Point Due to Dissolved Caseinates," by T. Brailsford Robertson and Theo. C. Burnett. Casein combines with bases to form "neutral" and "basic" salts of definite composition which produce a definite measurable depression of the freezing point. Estimations indicate a molecular weight of "basic" caseinates of 1,400; of "neutral," 2,000. "The Cerebrospinal Fluid in Certain Forms of Insanity, with Special Reference to the Content of Potassium," by Victor C. Myers. Analyses show that changes in the composition of cerebrospinal fluid occur after death. Protein-phosphates, and especially potassium, are increased. The protein content in dementia paralytica is increased during life. "Human Pancreatic Juice," by Harold C. Bradley. Examination of human pancreatic juice showed an average specific gravity of 1010; alkalinity equal to $N/20$—$N/10$ sodium bicarbonate; no definite relation between diet and enzyme content; no rennin, invertase or lactase; trypsinogen in all specimens, trypsin in 50 per cent. A study was made of the influence of various conditions upon the activity of lipase. "On a Modification of Lunge's Method for the Quantitative Estimation of Urea," by Clarence Quinan. Lunge's method (*Zeitschr. f. angew. Chem.,* 1890, p. 139) of reducing measurements of

gas volume to standard conditions applied to the estimation of urea in urine by the hypobromite method. "The Relation of Different Acids to the Precipitation of Casein and the Solubility of Cheese Curds in Salt Solutions," by J. L. Sammis and E. B. Hart. The amount of $N/10$ acid required to precipitate casein from a lime-water solution varies with the temperature, kind of acid and age of solution. The solubility of cheese curds in salt solution depends upon the kind of salt and the concentration. It is influenced by contact with acids. "An Endeavor to Account for the Transfer of Proteid in Inanition," by Albert Woelfel. An attempt to explain why some tissues waste more than others during inanition by comparison of autolytic and heterolytic digestions. Results negative. "Proceedings of the American Society of Biological Chemists," in session in Baltimore, December 28–31, 1908.

The Museums Journal of Great Britain for March describes "A Method of Mounting Eggs," by Raymond Bennett, in use in the Ipswich Museum; and Mrs. Roesler tells of "The Work of an Instructor in the American Museum of Natural History," whose work lay especially with children and teachers. There is a note on a "Conference on Indian Museums" at which eleven governments or states were represented and a variety of topics discussed.

The Zoological Society Bulletin for April is an Aquarium Number, devoted to things aquatic. It contains a description of "The Bermuda Aquarium," tells of "Frogs and Frog Raising," of the "Water-throwing Habit of Fishes in the New York Aquarium," of "The Solution of the Carp Problem" and "Angling and Water Pollution." Finally there is "A Photographic Study of the Ghost Crab."

The Museum News, of the Brooklyn Institute, is mainly devoted to a "Guide to the Exhibits Illustrating Evolution and the Preservation of Animals" and a "Guide to the Trees and Important Shrubs of Bedford Park."

The Bulletin of the Charleston Museum announces the beginning of a collection to illustrate the mineralogy of the middle and southern Atlantic states, to be known as the "Piedmont Mineral Collection."

BOTANICAL NOTES

It now turns out that the big cactus so common in Arizona, and which is a foot or so thick, and from fifty to sixty feet in height, is not a *Cereus* as had always been supposed. Under this generic name it had been known in books and reports as *C. giganteus.* A recent careful study of this plant by Drs. Britton and Rose has convinced them that its reference to this genus by Engelmann was erroneous, and they find that it is the type of a new and hitherto undescribed genus, which they name *Carnegiea* (*Jour. N. Y. Bot. Gard.,* Nov., 1908). Accordingly this striking cactus is hereafter to be known under the name of *Carnegiea gigantea* (Engelm.) Britt. and Rose.

Another genus has been segregated from *Cereus,* to which the name *Harrisia* has been given by Dr. Britton (*Bull. Torr. Bot. Club,* Dec., 1908). Three species from Cuba and Jamaica are now referred to this genus, and five new species from Cuba, Porto Rico, Haiti and the Bahamas are added.

A morphological paper of much more than ordinary importance recently appeared in the *Transactions of the Connecticut Academy of Arts and Sciences* (Vol. 14, pp. 59 to 170), under the title of "The Morphology of *Ruppia maritima,*" by Dr. A. H. Graves. This plant is a slender branching aquatic, grass-like in appearance and belonging to the family *Potamogetonaceae,* which contains other genera and species of "pondweeds." After a morphological and ecological study of the vegetative organs, the reproductive organs are taken up in a most satisfactory manner, followed by a study of embryo, fruit, seed and seedling. Thirty-three text illustrations and fifteen large, full-page plates with 121 figures help to elucidate the descriptions. A bibliography of 98 titles closes the paper. In his closing chapter devoted to a summary of the relationships of Ruppia to other Potamoge-

tonaceae the author finds evidence of reduction from "some form similar to the present submerged Potamogetons, with *Zannichellia* and *Althenia* serving as examples of still further reduction."

IN the *Botanische Zeitung* for November 1, 1908, H. Bruchmann's paper, "Das Prothallium von *Lycopodium complanatum* L." adds materially to our knowledge of the gametophyte generation of this species. The tissues of the erect, tuberous gametophyte are shown to consist of a rhizoid-bearing epidermis; a layer containing endophytes; a layer of radially arranged palisade cells, and a large-celled central mass of parenchyma. Branching occurs, giving rise to increased areas for the sexual organs. Some of these prothallia are unisexual and others bisexual. The sexual organs are crowded into dense masses at the summit of the prothallium and are of the usual type of structure.

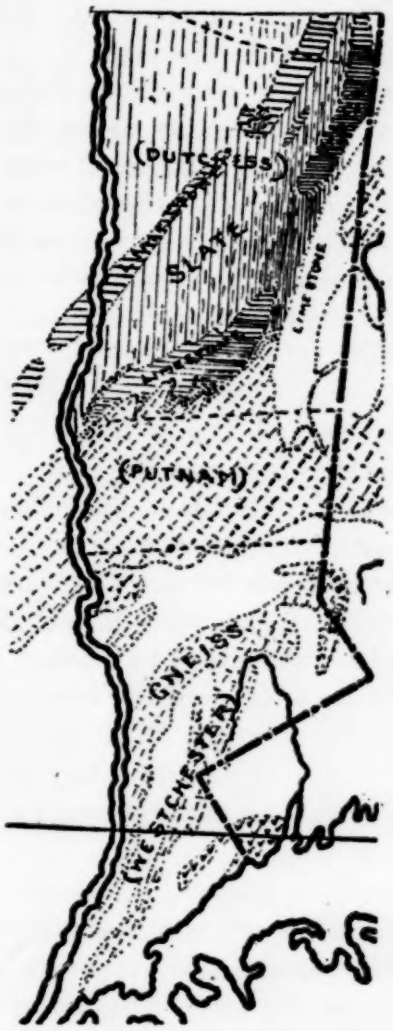
ALBERT MANN, expert in charge of special barley investigations in the Bureau of Plant Industry of the U. S. Department of Agriculture, makes a preliminary report of the results of his study of the problems of how to recognize the best grades of barley (Circular No. 16, issued November 25, 1908) in which he finds that "the diastatic and cytatic starch ferments are wholly the product of the scutellum and are secreted by its outer layer," and that there is so little of these ferments found in the starch cells that "it is practically negligible." Furthermore, "the aleuron layer has nothing whatever to do with this process," namely, the change of starch into a soluble form for absorption by the embryo, which is identical with what takes place in "malting." Hence the scutellum is the "malting organ," and that barley is best for malting purposes that contains the largest scutellum in the grain.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

SOME GEOLOGICAL PROBLEMS

AMONG the larger problems in the geology of eastern North America which to-day claim attention are: the determination of the eastward and southeastward extension in their metamorphosed condition of the less altered rocks of the Hudson Valley and the satisfactory separation from these of the pre-Cambric; as well as the separation and correlation of the divisions of the latter, if such exist.



J. D. Dana early essayed to show the continuity of the limestones and schists of the New York-Connecticut border with those of Westchester County, New York. F. J. H. Merrill took up the question later and reached practically the same conclusions. The work of Cook in New Jersey had shown how intimately the lower Paleozoics are involved in the Highlands of that state. Many of the facts seemed to point to a oneness in age of much of this limestone, schist and slate with the unaltered rocks to the north and west in the Hudson Valley and on the flanks of the Highlands.

The continuity of these rocks over large areas has been suggested and assumed rather than proved. Notwithstanding this they form a part of the same general problem, and any assumption regarding the age of one portion of this belt makes more imperative the need of better establishing the principles that will apply to the region as a whole. Any suggestion of incorrectness in age of any part raises the whole question to the fore.

Great uncertainty prevails in the minds of the Connecticut geologists as to the age of the greatly injected, disturbed and altered schists and limestones in the western part of that state. Manifestly any reasonable interrogation regarding the generally assumed age of the limestones and schists of southeastern New York is of great interest. The recent conservative suggestion of Berkey that the Inwood limestone and Manhattan schist are of pre-Cambric age is a case in point.

The work of Hitchcock and Emerson in Massachusetts, that of Percival, Dana and the Connecticut Survey in Connecticut, and that of Mather, Dana, Merrill and Berkey in New York has done much to unravel the complicated geology of this region; but much confessedly awaits solution. The problem is to a great extent a structural one and is complicated through metamorphism by igneous intrusion.

Limestones are known in the pre-Cambric rocks of Massachusetts, southeastern New York and New Jersey in the proximity of limestones of younger age. The uncertainty is not at this point, but as to which is which. The work of Cook, Britton, Nason and Bayley does not leave us clear as to what is assignable to the pre-Cambric and what to the Paleozoic in the Highlands of New Jersey. The New York geologists are working at this problem, and the New England geologists will doubtless take the subject up again in the near future.

Much doubtless depends upon the success we may attain in correlating areas with one another as well as in establishing principles that will fit them all, and to what extent such a thesis as may be drawn up can be supported by actual evidence, or reasonable inference, or both. With these general principles our interpretations of specific phenomena must fit if the principles are to stand.

The Geology of Dutchess County, New York.[1]

The study of these problems reasonably begins with the examination of the least altered strata of the Hudson Valley. These strata, showing continuously increasing metamorphism as they are traced eastward, are well displayed in Dutchess County. Field work in this county reveals that the metamorphism approaches the character of a function of the distance of the strata from the Hudson River. The increment by which the metamorphism approaches a given degree varies in value, but apparently always is greater per unit distance as one approaches the southern part of the county. The fact that the pre-Cambric rocks cut through the southeastern and southern portion of the county indicates that the degree of metamorphism may, in a measure, be directly connected with the proximity of the Highland mass.

The accompanying generalized sketch map is not intended to show the details of the areal geology of southeastern New York but rather to show pictorially the character of the general problem. It is based upon personal work in Dutchess County, particularly in the Poughkeepsie quadrangle, and upon the maps of Dana, Smock, Merrill and Berkey.

The north and south continuity of the western limestone belt (Barnegate or Wappinger) of Dutchess County was shown by W. B. Dwight. The identity of the eastern so-called Millerton-Fishkill belt with the Wappinger was proved for its northern or Millerton portion by the same worker. Recent work by the writer in the southern portion of the eastern belt, the Fishkill limestone, shows conclusively by the discoveries of fossils the presence of Georgian and Beekmantown terranes within this formation.

While considerably more metamorphosed than the Wappinger the alteration of the eastern limestone has not obliterated the

[1] Published with the consent of the New York State Geologist.

evidence of its age. The identity of the northern and southern portions of this belt is thus shown, and the eastward metamorphosed extension of the rocks of the Wappinger belt is likewise demonstrated. The intrarelationships of the western Wappinger are in some cases duplicated in part in the eastern belt. With these facts in mind the shading on the map is designed to show the gradation in metamorphism to the eastward.

To the east and south on the map are extensive areas of limestone and schist, for the most part left unmarked and unbounded, the satisfactory proof of the age of which awaits demonstration. Smaller patches not represented on the map, more intricately involved and often associated with igneous rocks, are scattered here and there in the Highlands. The great complex extends eastward into Connecticut, and southwestward into New Jersey, and has its representatives to the north in Vermont and Massachusetts. That it is a puzzling area is stating the case mildly. It must be attacked with a mind open for the reception of data bearing on the question of the possible genetic identity of extensive and disconnected masses or for the consideration of features that point the other way. The structure of the region must be unraveled and the earlier relationships of the component rocks restored. Moreover, it may be considered an open question, if with the changes that the pre-Cambric rocks had early undergone, the later deformations and metamorphic agencies would not have produced a relatively greater alteration in the younger rocks.

It is purposed to discuss more fully certain features of the general problem in a forthcoming report on the geology of the Poughkeepsie quadrangle.

C. E. GORDON

AMHERST, MASS.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION G—BOTANY

SECTION G of the American Association for the Advancement of Science met during convocation week at Baltimore, the sessions being held at the Eastern High School. The attendance of botanists was unusually large and representative, and so many papers were offered for presentation that it was found necessary to divide into subsections. In Subsection A were presented the papers in morphology, physiology, ecology and taxonomy, while the papers in pathology were presented in Subsection B. Vice-president Richards presided over Subsection A, and Dr. F. L. Stevens, of the North Carolina College of Agriculture and Mechanic Arts, was chosen by the section to preside over Subsection B. As at the Chicago meeting the program of the section interlocked with that of the Botanical Society of America, so that program conflicts were reduced to a minimum. The address of the retiring vice-president, Professor Charles E. Bessey, on "The Phyletic Idea in Taxonomy," has been published in full in SCIENCE.

The following officers were chosen:

Vice-president—Professor D. P. Penhallow, McGill University, Montreal, Canada.

Member of the Council—Joseph N. Rose, U. S. National Museum, Washington, D. C.

Member of the Sectional Committee (five years)—Dr. D. T. MacDougal, Carnegie Institution, Tucson, Ariz.

Member of the General Committee—Professor Aven Nelson, University of Wyoming, Laramie, Wyo.

In view of the increasing difficulty of arranging the program in an equitable manner, the sectional committee appointed the retiring vice-president, Professor H. M. Richards, the incoming vice-president, Professor D. P. Penhallow, and the secretary, Dr. Henry C. Cowles, as a special program committee for the Boston meeting. In view of the coming meeting of the British Association at Winnipeg, the choice of a Canadian botanist for the vice-presidency of the section is regarded as most fortunate, and although no specific action was taken by the section at Baltimore, it was the general consensus of opinion that the American botanists should do all in their power to make the sojourn of the British botanists in America pleasant and profitable.

Abstracts of the technical papers presented at Baltimore follow, arranged in the order given in the respective subsections:

SUBSECTION A

Bog Toxins and their Effect upon Soils: ALFRED DACHNOWSKI, Ohio State University, Columbus, Ohio.

In a previous communication (*Bot. Gaz.*, 46: 130–143, 1908) attention was called to experi-

mental data showing that the inhibiting factors of bog conditions are in part due to the presence of injurious toxic water-soluble substances, reactions of the plants themselves, that such toxicity can be corrected by various methods, and that the plants grown in solutions thus treated show not only accelerated growth and an increase in transpiration, but also an increase in the green and dry weights of the plants.

Further experiments were undertaken to determine whether the toxins of bog water which are harmful to agricultural plants in water cultures are injurious also to plants growing in soil. A series of soils, ranging from pure quartz, sand and clay to humus were infected by shaking each with bog water, and filtering off the solutions. The results of these experiments indicate: (1) that the bog solutions thus treated become highly beneficial, (2) that soils absorb the toxins present in bog water, (3) that the soils are infected when treated in this manner and cease to yield a normal growth of plants when compared with similar soils serving as controls.

Initiating Licheno-ecologic Studies in the Kentucky Mountains: Bruce Fink, Miami University, Oxford, O.

The writer has long felt that most of the problems of lichen ecology require an unusually long time for their solution and during the past few months has been able to initiate such studies in two places with a view to continuing the work begun through many years. The work in the Kentucky mountains was done on the forest reserve of Berea College, five miles from Berea, Ky. This locality in the foot-hills of the Cumberland Mountains was selected because the area is to remain undisturbed. Thirty-one areas of varying size and form were marked off, some of them left undisturbed after taking careful notes of the size and condition of development of the lichens within them, others denuded to a considerable depth below the surface of the soil or rock, while on others the plants were only partially destroyed, the object being to watch the rate of growth, invasion, regeneration, etc. The areas were numbered and dated, and were selected in groups so that the study of ecologic factors to follow with instruments may be facilitated as much as possible.

Descriptions of Species of Opuntia: David Griffiths, U. S. Department of Agriculture, Washington, D. C.

An effort was made in the paper to show the relative value of diagnostic characters in this group of plants, and to show how different conditions radically affect these characters. A scale of points is made out to show a proposed sequence in descriptive literature. Stress was placed upon the necessity of field studies and descriptions drawn therein which shall describe the entire plant instead of a terminal joint or two, as has usually been done.

Physiological Studies on the Hymenophyllaceæ: Forrest Shreve, Carnegie Desert Laboratory, Tucson, Ariz.

Both physiological and anatomical evidence has been obtained to show that the leaves are the principal water-absorbing surfaces, and that there is very limited conduction of water in the vessels. Most Hymenophyllaceæ are capable of withstanding total submergence in well-aerated water for one month. Fragments of leaves with as few as ten cells are capable of maintaining normal appearance in dilute nutrient solutions for over one month. Most Hymenophyllaceæ are incapable of enduring a continued humidity as low as 60 per cent. Several hairy forms are able to endure low humidities of brief duration, and even occasional insolation. These forms are capable of surviving without liquid water if kept in air of over 90 per cent. humidity, and will continue to grow under these conditions. Isolated leaves show an ability to gain steadily in weight when kept in moist air, whereas controls killed in various reagents lost weights as did also the leaves of other species without hairs.

The Life History of Griffithsia Bornetiana: I. F. Lewis, Randolph-Macon College, Ashland, Va.

The vegetative structures, tetraspores, antheridia, procarps and cystocarps were described in detail, as well as the germination of the spores and the development of the sporelings. Antheridia, cystocarps and tetraspores occur on separate individuals which are almost identical in vegetative structure. The size, shape and arrangement of the cells are the same in the different forms, as are also the size of the nuclei and the number of nuclei in each cell. In mitosis, however, the nuclei of the sexual plants show seven chromosomes, and the nuclei of the tetrasporic plants about twice that number. The reduction of the number of chromosomes takes place in the two divisions in the tetraspore mother cell. The double number is restored by the union of the gametes. The conclusion is drawn that the carpospores, on germination, give rise to tetrasporic plants and the tetraspores to sexual plants. In the alternation of generations thus arising, the sexual plants are to be considered as forming the "x-genera-

tion," while the "2x-generation" comprises the sporogenous cells of the cystocarp and the entire tetrasporic plant. It seems hardly likely, however, that the tetrasporic plants are analogous, save in the number of chromosomes, to the sporophyte of the archegoniates.

Vegetative Reproduction by Induced Root-regeneration in the Guayule: FRANCIS E. LLOYD, Alabama Polytechnic Institute, Auburn, Ala.

Parthenium argentatum (the Mexican guayule) and *P. incanum* (the Mexican mariola) are two woody perennials belonging to the Compositæ and are found in the northern part of the central plateau of Mexico. A comparison of these two species discloses certain differences in the methods of vegetative reproduction which have already been described by the writer. These differences appear to be quite constant in nature. It is, however, possible by experimental methods to force the guayule (*Parthenium argentatum*) to adopt the method of vegetative reproduction which is normally followed by the mariola (*Parthenium incanum*). The paper, of which this is an abstract, describes the experimental conditions and the results obtained.

The Morphology of the Peridial Cells in the Roesteliæ: FRANK D. KERN, Purdue University, Lafayette, Ind.

The value of the sculpturing on the peridial cells as a specific character in defining the species of *Roestelia* has already been ably pointed out by Dr. Ed. Fischer and a number of the American forms have been figured and described by him. Aside from the surface markings there are a number of other features about the peridial cells which are worthy of consideration. It is for the purpose of setting forth the microscopical structure with some detail that this paper is presented. The part played by the peridial cell in making the different appearance between the forms of *Roestelia* and *Æcidium* is discussed. The chief attention, however, is given to the various types of cells and to an explanation of the terms used in describing them. Concrete examples, including many little-known species in addition to the more common ones, are given, together with a number of illustrations.

The Effect of Certain Salts upon Transpiration and Growth in Wheat: HOWARD SPRAGUE REED, Virginia Polytechnic Institute, Blacksburg, Va.

An investigation has been made of the effect of some chemical compounds upon the amount of transpiration per unit of growth in wheat plants. The results are expressed in terms of the units of water transpired per unit of increase in plant substance and by curves which show graphically the increments in transpiration and growth in comparison with control cultures. The data were obtained from several thousand wheat cultures grown in a variety of soils in paraffined wire pots, or in water cultures. Salts of sodium and potassium decrease the amount of water transpired per unit of growth, while salts of calcium and some other substances exert the opposite effect. Increasing the concentration of a salt usually exerts a different effect upon the curves of transpiration and of growth.

The Peg of the Cucurbits: WILLIAM CROCKER, University of Chicago, Chicago, Ill., and LEE I. KNIGHT, University of Illinois, Urbana, Ill.

The peg of the cucurbits is a parenchymatous outgrowth between the root and the stem which aids in the removal of the coat during germination. In the Hubbard squash and some other forms all seedlings produce ring-like pegs approximately equal on all sides (or at least on the two broader faces) if arching and contact are avoided. Under similar conditions in the Big Tom pumpkin and a number of other cucurbits a considerable per cent. of pegless seedlings appear. The functioning of this organ is possible only by its development on the concave side of the arch. The one-sided development is determined by the arching (including perhaps the growth strains preceding the actual arching) of the hypocotyl. Two stimuli aid in the production of the arch-contact of the coats and gravity. The contact of the coats is by far the more effective, for it will induce very sharp arching even against gravity. Gravity, independent of contact, gives strong enough arching to produce only one-sided pegs in all seedlings when the seeds are deviated 170° from the (point downward) vertical position. There is no evidence, contrary to the conclusion of Darwin, Noll and others, that gravity directly stimulates the lateral placement of this organ.

The Effect of Illuminating Gas and its Constituents on Carnations: LEE I. KNIGHT, University of Illinois, Urbana, Ill., and WILLIAM CROCKER, University of Chicago, Chicago, Ill.

The flowers of the carnation are extremely sensitive to traces of illuminating gas in the air, while the vegetation is comparatively resistant. In the Boston Market and pink Lawson varieties three days' exposure to 1 part in 40,000 kills the young buds and prevents the opening of those already showing the petals. The buds of medium age are considerably more resistant. In the same

varieties 1 part in 80,000 causes the closing of the open flowers upon twelve hours' exposure. This injury takes place directly on the bud or flower exposed and not indirectly through absorption by the roots. No chemical test is delicate enough to detect the least trace of illuminating gas in the air. Ethylene is even more fatal to the flowers of the carnation. Three days' exposure to 1 part in 1,000,000 prevents the opening of buds just showing the petals. Twelve hours' exposure to 1 part in 2,000,000 causes the closing of flowers already open. There is much evidence that indicates that the toxic limit of illuminating gas upon these flowers is determined by the ethylene it contains.

Types of Cactus Genera, 1753–1904: J. N. Rose, Smithsonian Institution, Washington, D. C.

Linnæus in 1753 referred all the cacti known at that time to one genus, which he called *Cactus*. Otto Kuntze in 1904, one hundred and fifty years afterwards, recognized but three genera; two of these, *Pterocactus* and *Pereskia*, are small or contain less than a dozen species, and hence the great mass of cacti are to-day to be found in the genus *Cactus* as understood by Linnæus. This might indicate that Linnæus's conclusions were good, but, as we all know, Otto Kuntze was a poor botanist, although he was a great bibliographer and doubtless did more than any one in modern time to stimulate botanical bibliography. Since Linnæus's time 58 genera have been proposed.

What are the types of these genera? Naturalists are now all agreed that the type of a genus must be one of the original species in it. At the present time, however, we have two genera of cacti which do not contain any of the original species and of course are used in an entirely different sense from that which was first intended. These genera are *Pilocereus* and *Epiphyllum*.

Botanists are now pretty well agreed that we ought not to use a homonym of an older genus, and yet we have at the present time in cacti two names which come under this class, viz., (1) *Harriota* DC., 18—, while there is *Harriota* Adans, 1762, also a cactus; (2) *Mamillaria* Haw, 1812, while there is *Mamillaria* Stackh, 1809, a genus of algæ.

Botanists are now pretty well agreed throughout the world that our nomenclature should begin with 1753 and that older names shall not displace Linnæan and post-Linnæan names, but at the present time we have in cacti one pre-Linnæan name which was not taken up until 1827, viz., *Melocactus*.

In the paper as presented there follows an alphabetical list of the genera of cacti, showing the date of publication of the genus, the number of original species and the names of the type species.

Some Variations and Hybrids of Œnothera: R. R. Gates, University of Chicago, Chicago, Ill.

The extreme variant of *O. rubrinervis* which appeared[1] in my cultures is found to breed true to its peculiarity. The presence of red on the hypanthium and in excess on the sepals is correlated with its development in excess on the under surface of the rosette leaves. The same correlation exists in one of the types from *O. nanella* × *O. biennis*. The *O. biennis* in these crosses was from the type growing wild around the New York Botanical Garden. Seven plants germinated from this cross and five of them reached maturity. These were of two sorts, four of which belonged to one type. In this type the rosette leaves were long, rather narrow and pointed, like *O. rubrinervis*. The petioles were red above but more conspicuously so on the under surface. The buds were large like *O. Lamarckiana* and, like the extreme variant of *O. rubrinervis* mentioned, the hypanthium and sepals were red throughout. The excessive development of red pigment from a cross between two types, neither of which shows much red, is an unexpected result several explanations of which are possible. In the second type the buds were small and greenish, showing the *O. biennis* characters.

O. Lamarckiana × *O. biennis*. Nine plants matured, all of one type. The rosettes were very much like *O. nanella* × *O. biennis*, type I, but larger, and the petioles were bright red above but without red on the under surface. The buds showed the *O. biennis* characters, being small, with little red on the sepals and with a short style. The petals varied in size from that of *O. biennis* to intermediate between *O. biennis* and *O. Lamarckiana*.

These crosses were made by Dr. D. T. MacDougal, who presented the seeds to the writer for further cultures.

An interesting "combination type" appeared in a culture of English evening primroses which contain some of the mutants of *O. Lamarckiana* and in addition some new types. The type in question showed the characters of *O. Lamarckiana* in its rosette and stem leaves (absence of red) but the buds were typical *O. rubrinervis*. This combina-

[1] See Science, 27: 209, 1908.

tion type might be called *O. Lamarckiana rubrinervis.*

On the Nature of the Fertile Spike in the Ophioglossaceæ: M. A. CHRYSLER, University of Maine, Orono, Me.

A study of the vascular system of the leaf in the Ophioglossaceæ supports the view that the fertile spike is to be regarded as two fused pinnæ, viz., the two basal ones, which are comparable to the fertile pinnæ of *Osmunda Claytoniana* and *Aneimia* spp. It is found in *Botrychium* that the vascular supply of the fertile spike is double; that the two bundles arise from a curved leaf-trace, at or near its extremities, and higher up approximate but do not fuse. The vascular bundles of the sterile pinnæ arise in a manner identical with that of the vascular bundles of the fertile spike. The mode of origin of the bundles of the fertile spike in each species of *Botrychium* examined may be paralleled by that seen in various genera of ferns, especially *Osmunda.* The genus *Ophioglossum* may be derived from the simpler species of *Botrychium,* while *Helminthostachys* shows certain complications. These facts point to the conclusion that the Ophioglossaceæ are to be regarded as a specialized family of ferns, rather than as a primitive order of pteridophytes.

Origin of Heterospory in Marsilea: C. H. SHATTUCK, Clemson College, S. C.

It is possible by means of a spray of cold water to kill the megaspores, which occur only in the oldest sporangia and then, putting the plant under good conditions, to mature sporocarps without megaspores. The greatest variation occurs when the megaspores and oldest microspores are blasted. Enlargement does not appear among the microspores when less than half the spores abort, and the surviving spores are larger the greater the amount of abortion. The mother cells may be checked in their development till the tapetal nuclei completely invest them. A perinium will then form around the four nuclei, sometimes enclosing them during the first and second mitoses. In such cases the sporangium invariably contains sixteen large bodies, each containing four nuclei. At other times when growth is less checked, the spores are more or less completely free and show great variation in size and shape.

The contest for supremacy among the young megaspores is very evident, many of them assuming considerable proportions, but one, centrally located, invariably secures the ascendancy. Sometimes the contest is very close between two or more members of the same tetrad. Very often the surviving member will carry attached to its papilla the aborted members even to germination.

The enlarged microspores vary in size from eight to sixteen times that of the normal ones, the nucleus shifting from a central (normal) to an apical position as in the megaspores. As vacuolation is more extensive the shape of the nucleus also varies from the normal spherical form to the oval, and finally, in the largest to the meniscus shape in the megaspore.

In extreme cases of abortion in the microsporangia only one spore survives which is about sixteen times as large as the normal microspore. The aborted tetrads remain as in the megasporangium, but better developed, thus showing a sharper contest for supremacy.

In plants kept from fruiting till September 1, many microsporangia (by position) developed megaspores and a few megasporangia developed microspores. In such cases the megaspores were intermediate in size and were also more nearly the spherical shape of the microspores. A few cases were noted in which the megaspores did not develop a perinium but enlarged considerably and became gorged with starch. *Marsilea* may be made to repeat, under culture, all the phases in the development of heterospory reported by Williamson and Scott for both *Calamostachys Benneyana* and *C. Cosheana.*

Movements and Reactions of Fern Spermatozoids: W. D. HOYT, Johns Hopkins University, Baltimore, Md.

The movements of the spermatozoids of ferns are complex and varied and depend on the conditions in which they are placed. When the conditions are unfavorable, they frequently reverse their direction of rotation, and they swing their anterior ends through a larger spiral and change their direction of movement more often than they do when in favorable conditions. The result of this is favorable to the organism in that they come in contact with a larger amount of the medium and so stand a better chance of reaching favorable conditions if these exist anywhere within the medium.

Different spermatozoids may react differently to the same stimulus at the same time, and the same spermatozoid may react differently to the same stimulus at different times. In some cases these differences in behavior can be ascribed to differences in physiological condition induced by different past experiences.

The cases where the movements have been sufficiently slow for exact analysis indicate that ori-

entation is attained by a series of random movements continued until a position favorable to the organism is reached, and not by a direct modification of the motor mechanism due to the local action of different concentrations of the medium on different portions of the body. This conclusion seems reasonably certain for negative reactions and probably for positive ones. The results obtained so far indicate that the movements and reactions of fern spermatozoids are of the same nature as those described for protozoa.

Some Aspects of the Mycorhiza Problem: Benjamin C. Gruenberg, DeWitt Clinton High School, New York, N. Y.

Mycorhiza is found on the roots and underground stems in many families of plants. The identity of the fungus in the symbiosis has been determined in but few cases, and in these not always with certainty.

Many theories as to the relationship between fungus and phanerogam have been offered, but none fits all the facts. It is, however, not to be expected that the mycorhiza has the same significance in all cases: in the different forms the relationship may be of different types, as nitrification, humus disintegration, water absorbing or storing, etc.

To the mycorhizas occurring in plants free from chlorophyll, there has been ascribed the function of obtaining organic nutrients directly from the humus. In several species of *Corallorhiza* examined there are present considerable quantities of starch, notwithstanding the entire absence of chlorophyll from the plants. The constituents of the humus that may yield carbohydrates, and the mechanism for the conversion of these materials into starch remain to be determined.

The solution of certain practical problems, as some in forestry, the transplanting of certain trees, tuberization, nitrification of the soil, etc., may have to wait upon the solution of some of the problems presented by the mycorhiza.

The Morphology of Salvinia (preliminary): Wanda M. Pfeiffer, University of Chicago, Chicago, Ill.

The early stages in the development of sporocarps are as described in Juranyi's "Ueber die Entwickelung der Sporangien und Sporen von *Salvinia natans*" (1873). In the young condition megasporocarps can be distinguished from microsporocarps only by the relatively smaller number of sporangia which they contain.

Later stages in the development of sporangia are very different from Juranyi's figures, since the tapetum was never observed to become two-layered, although the tapetal cells were often multinucleate, and since in no case were there more than eight spore mother cells found in either megasporangium or microsporangium.

The behavior of abortive megaspores was as described by Heinricher, in so far as the position taken by such spores is concerned. The activity of these spores in the formation of the perineum, however, is extremely doubtful since this seems to be entirely built up by the activity of the large, deeply staining tapetal cells.

The relationship of *Azolla* and *Salvinia* is still an open question.

A Preliminary Account of Dioon spinulosum: Charles J. Chamberlain, University of Chicago, Chicago, Ill.[2]

Dioon spinulosum is a Mexican plant and has been known only from the leaves and some small trunks. The plant was found in abundance at Tierra Blanca and at Tuxtepec in March, 1908. The trunk is often six meters in height and occasionally reaches a height of 16 meters. The ovulate cones are very large, elongated ovoid, about 70 centimeters in length and about 30 centimeters in diameter. They often weigh 14 kilos. The sporophylls are comparatively much shorter than in *D. edule* and the seed much larger. The staminate cone is ovoid and measures about 21 × 10 centimeters. Material is being secured for an extended study.

Demonstration of Seedlings of Selaginella sempervirens: Francis E. Lloyd, Alabama Polytechnic Institute, Auburn, Ala.

A Statistical Criterion for Species and Genera among the Bacteria: C. E. A. Winslow, Massachusetts Institute of Technology, Boston, Mass.

The existence of an almost infinite number of minute varieties has so far almost nullified any attempt at a natural classification of the bacteria. The vast numbers of generations which succeed each other in a short space of time, the absence of the swamping effect of amphimixis and the direct effect of the environment all help to make boundaries indistinct among these simple forms. The attempt has been made by the author and his colleagues to attack the problem by the statistical method, and the genera and species of the Coccaceæ have been mapped out in the following way: A number of characters (mostly biochemical, for it is precisely along physiological lines that the bacteria have differentiated, as the higher forms

[1] Investigation prosecuted with the aid of a grant from the Botanical Society of America.

have varied along morphological ones) were measured in a series of 500 cultures by quantitative methods. The results when plotted and compared showed that, on the average, certain properties were notably correlated with each other, and with particular habitats. A parasitic and a saprophytic subfamily were clearly distinguished and within each subfamily several genera were established based on the general correlation of several independent properties. Within the genera each distinct modal point for a particular character was given specific rank. A species is therefore one of the centers about which the numerous existing varieties are grouped; and according to this method a species can be defined, not by the description of an individual, but only by the statistical study of a considerable series.

Effect of Age on the Venation of Leaves: H. M. BENEDICT, University of Cincinnati, Ohio.

The size of the small areas into which the leaves of dicotyls are divided by veinlets is affected by the age of the plant which bears the leaves. The younger the plant, the larger are these "vein islets."

That the size of these areas is not merely a measure of the available nutrition is shown by the fact that leaves from water-shoots which are usually of larger size than normal show smaller areas than smaller leaves from younger plants. Young and old plants growing under the same conditions of environment show the characteristic difference in venation.

As an example of the relation between age and size of areas, some data from a study of *Vitis vulpina* L. may be given. Ten mature leaves from different parts of each vine were taken; pieces 4 by 10 mm. were cut from the same part of each. These were arranged in series and photographed by transmitted light and the number and size of the areas calculated. Since the material was collected where it was impossible to cut down the vines the relative ages of the plants were judged by the diameters of the stems. Care was taken to select vines growing under the same conditions.

Vitis vulpina L.

Diameter of Vine	Average Area of Vein Smallest	Islets in sq. mm. Largest	Average Area for Plant
¼ inch	.49	.51	.50
½	.39	.41	.40
¾	.36	.39	.37
3	.25	.29	.27
6	.12	.16	.14

Observations were made on *Ulmus americana, Castanea dentata, Quercus alba, Q. rubra, Tilia americana, Acer saccharinum, Fraxinus americana* and *Vitis bicolor.*

The Perennation of Cuscuta Epithymum Murr: F. C. STEWART and G. T. FRENCH, New York Agricultural Experiment Station, Geneva, N. Y.

Although Kühn proved clover dodder to be perennial, by observations made in Germany forty years ago, the belief is still current that the species of *Cuscuta* are all annuals. With the exception of a brief note by the senior writer there is no record of any dodder in the United States surviving the winter in the thread form. Yet our observations indicate that *Cuscuta Epithymunt* is frequently perennial. During the past three years this species has lived over winter in New York alfalfa fields, hibernating on the crowns of alfalfa, red clover and certain weeds. This is not accidental or occasional, but of common occurrence. In the writer's opinion it is the chief method by which dodder is carried over from one year to the next in New York alfalfa fields.

The First Generation Offspring of Œnothera lata ♀ × *O. gigas* ♂*:* ANNE M. LUTZ, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

(No abstract is published, because the full paper has appeared in SCIENCE.)

The Plant Formations in Eastern Colorado, and What They Indicate: H. L. SHANTZ, U. S. Department of Agriculture, Washington, D. C.

Three chief plant formations are recognized. They are discussed with respect to general appearance, types of root systems, the water relation of the soil, the influence of breaking the native sod, and the changes which bring about secondary and primary succession.

Notes on the Anatomy of Juncus (preliminary): AMON B. PLOWMAN, Beaver, Pa.

In their minute anatomy the Juncaceæ are strikingly similar to the more aerenchymatous representatives of the Cyperaceæ, such as *Dulichium, Eleocharis* and the limicolous species of *Scirpus.* The central cylinder of the rhizome shows typical amphivasal fibrovascular bundles, which are more numerous and more highly developed in those species of which the rhizomes are short and compact. In the aerial stems showing nodes, the nodal complex is similar to that in *Dulichium.* The reproductive axis contains only simple collateral bundles, arranged in the typical dicotyledonous order.

Are Alpine Plants exposed to Increased Evaporation? Charles H. Shaw, Ambler, Pa.

Schimper, Flahault, Schroeter and others lay considerable emphasis on the fact that alpine plants are exposed to more rapid evaporation. Their statements appear to rest on the fact that air movement increases and pressure decreases with altitude, and upon instances of apparent rapid drying, and upon the xerophilous character of many alpine plants.

During the summer of 1908 two series of porous cup atmometers were set up in the Selkirks at altitudes ranging from 800 to 2,788 meters. The stations from 800 to 1,700 meters (first series) were on the same hillside, had the same exposure, and were separated by a total horizontal distance of less than one kilometer. Those from 1,800 to 2,788 meters (second series) were located as far as possible with similar exposure on Mt. Grizzly, and included a horizontal distance of about one and a half kilometers.

Two stations were chosen at each altitude, since a substantial agreement would afford a test of the reliability of the scheme. The instruments of the first series were in continuous operation twelve weeks and those of the second series, for shorter periods. The weather was unusually favorable, there being little rain, clouds or frost during a term of seven weeks. Weekly readings were taken. In most cases the instruments of the several pairs gave approximately the same result.

The maximum in every case was found at the second station, at 1,100 meters altitude. At increasing altitudes, there was a gradual and irregular diminution.

The results of the first series appear to be unquestionable, as also a certain portion of the second series. Taken together they seem to exclude, so far as these mountains are concerned, the idea that evaporation increases with altitude.

Possibly the standard writers may have overlooked the part played by temperature, which is a factor in the evaporation rate, and might more than counterbalance the results of the other two factors.

The above data represent only weekly totals. The possibility of excessive evaporation at high altitudes during certain portions of the day remains to be studied.

Mitosis in Œdogonium: A. H. Tuttle, University of Virginia, Charlottesville, Va.

A brief review was given of the work of previous observers, and a statement of facts that appear to have been overlooked by them, or whose significance has not been noted.

Attention was particularly directed to the change in size and the marked change in form of the dividing nucleus; and, in addition, to the persistence of a distinct nuclear contour until a very late stage in the anaphase, also to noteworthy features in the mode of formation of the chromosomes, and in their behavior before, during and after splitting. Facts of importance regarding the formation and persistence of the achromatic figure were also presented, with others pertaining to the behavior of the daughter nuclei.

Preliminary Notice of Physiological Studies on Papaver somniferum: R. H. True and W. W. Stockberger, U. S. Department of Agriculture, Washington, D. C.

This paper discusses some studies made on the opium poppy, showing the distribution of oxidizing enzyms in the plant, the distribution of morphin and the relation of morphin production to oxygen.

The following papers were read by title:

Orientation of the Cotyledon of Wheat and Corn Seedlings Stimulated by Light: S. O. Mast, Woman's College, Baltimore, Md.

Some Fundamental Errors in Botanical Teaching: E. C. Jeffrey, Harvard University, Cambridge, Mass.

Methods of Demonstrating the Oxidizing Power of Roots: Howard S. Reed, Virginia Polytechnic Institute, Blacksburg, Va.

The Collection and Storage of Tree Seed: Hugh P. Baker, Pennsylvania State College, State College, Pa.

Preliminary Report of the Result of Observations on the Relation of Evaporation to the Treelessness of the Prairies: Bohumil Shimek, University of Iowa, Iowa City, Ia.

A Summer Laboratory for Mountain Botany in Colorado: Francis Ramaley and W. W. Robbins, University of Colorado, Boulder, Colo.

The Morphology and Development of the Cystocarp in Callithamnion Baileyi: R. P. Hibbard, Mississippi Agricultural Experiment Station, Agricultural College, Miss.

SUBSECTION B

Two North Carolina Plant Diseases: Hypochnose of Apple and Colletotrichose of Fig: F. L. Stevens and J. G. Hall, North Carolina College of Agriculture and Mechanic Arts, West Raleigh, N. C.

Hypochnose of apple, pear and quince, which is widely distributed throughout the United States,

but of which the causal fungus has not been before recognized except by Noack in Brazil, is described and notes on its geographical distribution given. Colletotrichose of the fig, *Ficus Carica*, is described and its causal fungus, *Colletotrichum Carica* n. sp., characterized.

A Bacterial Rot of the Muskmelon: N. J. GIDDINGS, University of Vermont, Burlington, Vt. (Read by L. R. Jones.)

One fourth of the fruit in a field of Montreal muskmelons at St. Albans, Vt., was ruined by soft rot in the autumn of 1907. This has been proved to be due to a new species of *Bacillus* which will be described in detail and named in the next Annual Report of the Vermont Experiment Station. Its characters in brief summary follow: 1–1.7 μ by .6–.9 μ. Actively motile by 4–6 peritrichic flagella. No endospores; not stained by Gram's method.

(Gelatin cultures at 20° C., others at 30° C.)

Nutrient broth: Strong clouding in 24 hours; no pellicle or ring formation; slight sediment. Agar stroke: abundant, slightly spreading, contoured, slimy, glistening, translucent-opalescent, growth, umbilicate in elevation. Agar stab: filiform. Agar plate: colonies round or amœboid. Gelatin stab: infundibuliform liquefaction in two days. Milk: coagulation and some separation in two days; acid production of + 55 in twenty-one days. Fermentation broths: growth in closed arm in saccharose, dextrose, maltose, lactose, mannite, urea, asparagin, not in glycerin. Vegetables rotted: muskmelon, citron, carrot, potato, beet, turnip. Indol production: slight. Nitrate reduction: abundant. Acid production: slight from carbohydrate broths; pronounced from milk. Ammonia production: strong from asparagin. Gas: slight from asparagin; abundant from milk. Over 99 per cent. of gas from milk was CO_2.

The White Pine Blight: PERLEY SPAULDING, U. S. Department of Agriculture, Washington, D. C.

This popular term includes several well-marked and distinct diseases: a leaf blight accompanied by *Septoria parasitica*, two leaf diseases caused by *Lophodermium brachysporum* and *Hypoderma lineare*, a leaf and twig blight caused by winter freezing and a twig blight probably caused by insects.

Some Toxic Properties of Tannic Acid: MEL T. COOK, Agricultural Experiment Station, Newark, Del.

Within recent years a great deal of work has been done in growing fungi on substances containing different chemicals and in studying the responses to the different stimuli. The series of experiments of which this is a part proposes to treat certain fungi with substances which occur in considerable quantities in the host plants. Tannic acid was selected as the first of these substances because it is so widely distributed and occurs in such great abundance, also because of its occurrence in abnormal growths. It is by no means well understood and is probably somewhat different in different families, genera and species. It has been studied by the chemists and pharmacologists but neglected by the botanists. It is frequently referred to as a waste product, although it is sometimes asserted that it may afford a protection against the attacks of insects, fungi, etc. It has been used to some extent as a germicide and fungicide.

This study has been divided into five series of experiments as follows:

First Series.—A study of the histology of pathological tissues; not treated in this paper.

Second Series.—The growing of fungi in pure media and in the same media to which has been added varying percentages of tannic acid. *Heterosporium, Ascochyta, Macrosporium, Phyllosticta* and *Rhizoctonia* are checked by small percentages of tannic acid. *Glœosporium, Colletotrichum, Cladosporium, Fusarium* and *Sphæropsis* were retarded in most cases, but in some instances were stimulated by small percentages of tannic acid. *Alternaria, Sclerotinia, Necosmospora* are stimulated by amounts not exceeding two fifths per cent. Those which are most strictly parasitic are more sensitive to tannic acid than those which are facultative saprophytes. A number of saprophytic forms were also used and were found to be stimulated by or at least to tolerate large quantities of tannic acid in most cases; this was especially true of wood fungi.

Third Series.—Consisted of growing fungi surrounded by barriers of tannic acid. Briefly discussed.

Fourth Series.—Consisted in treatment of fungi with varying percentages of tannic acid for varying periods of time and then placing them under favorable conditions for growth. In most cases the fungi were uninjured by this treatment.

Fifth Series.—Consisted in growing fungi through sheets of cork. Most fungi will penetrate cork readily if the tannin has been removed.

The Present Status of Rice Blast: HAVEN METCALF, U. S. Department of Agriculture, Washington, D. C.

The parasitism of a fungus of the genus *Piricularia*, announced before this section in 1906, and since confirmed by Fulton, has been verified by over six hundred inoculations. The parasite is a *vera causa*, although the occurrence of blast is enormously favored by a soil rich in nitrogen. It is doubtful whether a specific designation of the fungus can be made without revising the genus. The speaker's investigations in Italy in 1908 indicated the identity of blast with *brusone*, and tended to confirm the views of Farneti on the etiology of the disease. As *brusone* has already been shown to be identical with the *imochi-byo* of Japan and the *omo-mentek* of Java, the evidence is strong that blast is a world-wide disease which has only recently reached America. In Italy the disease is practically under control by use of resistant varieties of rice. These were imported by the author and will be tested in 1909.

A Few Diseases of Bamboo and Sedge: Flora W. Patterson and Vera K. Charles, U. S. Department of Agriculture, Washington, D. C.

This paper discusses a few diseases occurring upon these hosts, their morphology, systematic position and especially their economic significance in relation to future foreign introductions. It includes pathological and histological notes on species previously known to cause diseases and the description of a new genus.

Specimens of diseased bamboo, and specimens of diseased sedge with water-color illustrations of the latter, accompanied the presentation of the paper.

Pathological Notes Concerning a Few Ornamental Plants: Flora W. Patterson and Vera K. Charles, U. S. Department of Agriculture, Washington, D. C.

This paper discusses the occurrence of a *Botrytis* disease of peony and chrysanthemum, including cultural notes and statements as to preventive treatment.

A new disease on *Cyclamen* caused by *Colletotrichum* is described together with cultural notes on its development.

Necrosis of the Grape: Donald Reddick, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

Necrosis is a very common fungous disease of the cultivated Labrusca varieties of grape in New York state, and it occurs also on the white scuppernong grape in Alabama.

The disease may be recognized as follows: Vines trimmed and tied up which fail to put out shoots; a dwarfing of shoots and leaves and a light setting of fruit; leaves reduced in size, crimped about the margin and chlorotic; the sudden wilting of vines in late summer; the presence of longitudinally ribbed excrescences or tuberculous masses on any part of the stem; small, black, slightly sunken lesions on the green shoots.

This disease is caused by *Fusacoccum viticolum* n. sp. The fungus causes a dry rot in the stem, the effects on other parts, except lesions on the shoots, being purely physiological.

The fungus has been isolated from the interior of many diseased stems, from lesions on green shoots and from spores developed in stromata on the surface of dead parts. Pathogenicity is not yet absolutely demonstrated, but this is the only organism constantly associated with such conditions. The most serious effects of the fungus are found in very young vineyards and it is thought that this is due to the use of diseased cuttings for stock.

Root crowns are often free from disease and this affords a means of control, viz., by renewal with a sprout from the root.

A Blight of Cultivated Ginseng caused by Alternaria Panax n. sp.: H. H. Whetzel, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

The greater part of the million dollars' worth of ginseng now annually exported from the United States is grown under cultivation. Though but very recently brought under domestication, it is known to be subject to a number of diseases.

The most common and destructive disease is the so-called *Alternaria* blight. It is characterized by the appearance of brown cankers on the stems and large watery spots in the leaves which may eventually involve the entire leaf and top. Badly blighted plants appear as if drenched with boiling water.

The pathogenicity of the *Alternaria* constantly occurring in the lesions has been definitely determined by inoculation.

Experiments extending over three years have shown that it may be controlled by the thorough application of Bordeaux mixture.

On a Method of Developing Claviceps purpurea Tul. with Notes on Claviceps rubra n. sp.: H. H. Whetzel and Donald Reddick, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

Early in August, 1907, sclerotia of *Claviceps*

were collected in heads of Volunteer rye, and of roadside timothy in Noble County, Ind. August 20, 1907, sclerotia on *Dactylis glomerata* were collected at Ithaca, N. Y., and, on August 23, on *Festuca elatior*. On the latter date these collections of sclerotia were encased separately in ordinary wire screening and placed on the ground under a grape arbor to mature. April 6, 1908, all were brought to the laboratory and placed on moist sand in a covered stender dish. April 18, 1908, a few sclerotia in all dishes were found with developing stromata. At this time the stromata on timothy were further advanced and were very evidently different. Stromata from ergot on rye had mature perithecia about May 1, while those on *Dactylis* and *Festuca elatior* were mature May 6. May 23 all had fruited and gone.

The *Claviceps* on rye, *Dactylis* and *Festuca* all belong to the same species, at least morphologically, *i. e.*, *C. purpurea* Tul. A few sclerotia on *Phleum* unmistakably developed typical *C. purpurea;* most of them developed a Claviceps with much smaller stromata which are of an entirely different color, have fewer and more prominent perithecia, and these contain smaller spores. It seems to be an undescribed species. Careful search was made in June, 1908, for the sphacelial stage in the type locality but it was not found.

Some Little-known Diseases of Conifers found in Connection with a Disease Survey of our Western Forests: GEORGE GRANT HEDGCOCK, U. S. Department of Agriculture, Washington, D. C.

The disease survey of our western forests which is now being conducted by the Laboratory of Forest Pathology, although it has not passed the preliminary stage, has brought forth some interesting data concerning a number of wood-rotting fungi which may be properly classed as wound parasites. These cause great losses to the country by diminishing to a very considerable extent the available supply of mature timber. They do not occur uniformly in any given forest, but abound in certain favorable environmental conditions.

Echinodontium tinctorium is the cause of a destructive heart rot of living trees belonging to a number of species. It attacks the following species: *Abies nobilis* Lindl., *A. concolor* (Gord.) Parry, *A. grandis* Lindl., *A. lasiocarpa* (Hook) Nutt., *Tsuga heterophylla* (Raf.) Sargent and *Picea Engelmanni* Engelm. In a few localities as high as sixty per. cent. of *Abies* and nearly one hundred per cent. of *Tsuga* have been reported diseased by this fungus. The fungus usually enters the heart wood of the trees attacked either through a broken limb, fire scars or other wound. The mycelium evidently secretes a solvent for wood fibers, since they are often entirely dissolved in the later stages of the rot produced by the disease. The sporophores contain a red pigment which is especially characteristic of this species. This is used by the Indians for making paint for facial decorations, etc. The red coloring matter in the pigment is insoluble in the ordinary solvents, with the exception of the alcohols, which apparently dissolve out a yellow color.

Fomes laricis attacks the heart wood of a number of species of conifers. The fungus gains entrance into the heart wood in the same manner as *Echinodontium*. It has been found on the following species: *Pinus ponderosa* Laws., *P. Murrayana* "Oreg. Com.," *P. Lambertiana* Dougl., *Larix occidentalis* Nutt. and *Pseudotsuga taxifolia* (Lam.) Britton. The effect of this fungus on the heart wood of trees is somewhat different from that of *Echinodontium;* it does not so completely dissolve the wood fibers, but apparently carbonizes them, causing the wood to break up into blocks or rectangular pieces. Large sheets of punk or tinder are formed by the mycelium adjacent to sporophores in later stages of the disease. The decayed wood is of a red-brown color, resembling very much that produced by *Fomes pinicola* (Sw.) Gill., which is frequently the cause of a sap-rot of mature conifers, but is rarely found fruiting on living trees. *Fomes laricis* usually forms sporophores on living trees, but may in case of very large trees consume the heart wood for years before it brings forth fruiting bodies. The white chalky sporophores are often of very great size. They have been powdered and used as a medicine in Europe for ages, and owing to the bitter taste of the substance of which they are composed, have been designated as the "quinine fungus."

Several other wood-rotting fungi of lesser importance have been found in various localities, a study of which will be undertaken later. In our disease survey work the investigation of such problems is not confined to the immediate study of the parasite, its effect on the host and remedial and preventative methods. It is our purpose in the future to collect data upon the conditions in the forest which make the trees of certain areas more subject to disease than those of others in the same locality. This involves a study of the physical conditions of those localities where disease is prevalent in order to find out how they

vary from the conditions in adjacent localities where the trees remain healthy.

The Present Treatment of Monotypic Genera of Fungi: C. L. Shear, U. S. Department of Agriculture, Washington, D. C.

The following seven monotypic genera of fungi, *Cœlosphæria* Sacc., *Cryptosphæria* Grev., *Cylindrosporium* Grev., *Isothea* Fr., *Nœmaspora* Willd., *Septaria* Fr., *Sphæropsis* Lev., selected at random from the Pyrenomycetes and Fungi Imperfecti are cited as examples of the present condition of the nomenclature of the fungi as represented in recent general systematic works such as Saccardo, "Sylloge Fungorum," Engler and Prantl, "Pflanzenfamilien," Rabenhorst's "Cryptogamenflora" and Ellis and Everhart's "North American Pyrenomycetes." The rule adopted by the international zoologists and the American botanists that a monotypic genus must always contain its monotype appears to receive no particular recognition. The original monotypes of the genera mentioned have been transferred to other genera of later date and the original generic names are now applied to other groups of species and frequently attributed to other authors. The desirability of recognizing the fixity of monotypic genera and genera having a species specifically designated as type is suggested as an essential part of the rules to be formulated by the section of the International Botanical Congress which is to consider the nomenclature of cellular cryptogams at its meeting at Brussels in 1910.

A Bacterial Disease of the Peach: James Birch Rorer, U. S. Department of Agriculture, Washington, D. C.

For the past three seasons the writer has made observations on a disease of peach leaves, twigs and fruit, evidently caused by a bacterium.

The form on the leaves is the commonest and most widespread. It causes somewhat angular purplish-brown spots one eighth to one fourth inch in diameter, which soon drop out, giving a shot-hole effect. Serious outbreaks of the disease cause a premature defoliation of the trees. This leaf spot was first seen by the writer on peach leaves collected in Georgia in 1903 by Mr. P. J. O'Gara, of the Department of Agriculture. During the same season Clinton observed a disease, evidently the same, in Connecticut and reported in the Report of the Connecticut Agricultural Experiment Station for 1903, Part IV., page 337. In 1906, 1907 and 1908 the writer found the disease to be prevalent throughout the south and middle west.

In August, 1906, pure cultures of an organism were obtained from the leaf spots and in the following spring inoculations made with this organism caused spots in all respects similar to those from which the bacterium was originally obtained. The same organism was again obtained in pure cultures from the spots which were artificially produced.

The disease on the twigs was first observed in 1907 at Siloam Springs, Ark. It kills the bark of young shoots, forming purplish-black, slightly sunken areas one eighth to one fourth inch wide, which may extend for two or three inches along the stem. In 1908 this twig disease was found in an orchard in Bentonville, Ark. Numerous sections through the youngest spots showed the presence of bacteria in large quantities and by the poured plate method cultures of an organism similar to that from which the leaf spots were obtained. No attempt has been made as yet to produce this form of the disease by inoculation.

The disease on the fruit is very characteristic. It was found in two orchards at Bentonville, Ark., during the past season. It causes a very small purplish spot over which the skin soon cracks, in either a straight or an angular way. The spots are usually very numerous (two hundred and fifty have been counted on one side of a peach), and often coalesce so that the cracks become continuous and extend for an inch or more. Sections through the smallest spots showed that bacteria were present in abundance and evidently the cause of the trouble.

Though not entirely proved, it is assumed that the three forms of the disease mentioned above are caused by *Bacterium pruni* Erw. Smith, which causes the bacterial black spot of the plum, for the following reasons: (1) the leaf spot of plums caused by *B. pruni* is very similar in appearance to that of the peach; (2) by inoculation with pure cultures of *B. pruni*, spots may be produced on peach leaves similar in all respects to those occurring naturally; (3) the organism isolated from the peach leaf spot and twig spot have the same cultural characteristics in all the different media in which they have been grown as *B. pruni;* (4) though the organism has not been obtained in pure cultures from the peach fruit spots, the megascopic and microscopic appearance of these spots is identical with the small spots on the plums, especially those which result from late infections.

The Cause of Trembles and Milk Sickness: E. L. Moseley, Sandusky High School, Sandusky, O.

Experiments made in 1908 confirm the conclusion reached after experimenting on various animals in 1905, viz., that *Eupatorium ageratoides* is the cause of trembles and milk sickness. A rabbit with four sucking young was fed with this plant, causing trembles in all of them. Two of the young were killed and cooked and fed to a cat, causing trembles. Milk from a cow with whose food *Eupatorium* leaves were mixed caused trembles in cats and rabbits. The milk was found to contain aluminum and an increased quantity of magnesium. The urine of a rabbit fed with the weed contained much aluminum. These substances exist in large quantities in the ash of the plant, the amount of magnesium differing in plants from different sources. Magnesium nitrate mixed with the food of a rabbit produced trembling. The symptoms of trembles observed by those who have lost stock from this cause are the same as result from aluminum and magnesium compounds when they get into the blood.

Peach Yellows Disseminated by Nursery Trees: J. L. PHILLIPS, Blacksburg, Va.

Peach pits and buds are sources of infection. The disease does not usually appear in nursery stock. It appears in orchards in the second and third years. Peach pits should be sold under certificate of inspection.

A New Anthracnose Attacking Certain Cereals and Grasses: THOMAS F. MANNS, Ohio Agricultural Experiment Station, Wooster, O. (Read by A. D. Selby.)

This paper stated briefly the results of culture investigations of a fungus described as *Colletotrichum cereale*, n. sp. This has been found to be present generally over the state of Ohio, attacking the spikes, culms and sheaths of rye, the culms and sheaths of wheat, oats, chess, orchard grass, timothy, red-top and blue-grass. Upon the cereals the attack is timed to the approaching maturity of the plant and produces marked shrivelling of the grain. The behavior of the fungus on different media is stated, and different illustrations are included.

A New Bacterial Disease of the Sugar-beet Leaf: NELLIE A. BROWN, U. S. Department of Agriculture, Washington, D. C.

Last summer a new disease of the sugar beet was observed in the beet fields in Utah and California by Dr. C. O. Townsend, pathologist in charge of sugar-beet investigations, Department of Agriculture, Washington, D. C., who sent material to his laboratory for investigation.

The leaves had dark brown, often black, irregular spots from 3 mm. to 1.5 cm. in diameter. They occurred on the petiole, midrib and larger veins. Occasionally the discoloration extended along a vein some distance and the tissue on either side was brown and dry. An organism was plated out of these spots without difficulty and found to be a schizomycete. Inoculations were made in the greenhouse and in the open field at Garland, Utah. The infection did not fail to take in any case.

So far as the work has been carried, the organism is infectious to the sugar-beet root, leaves of lettuce, sweet pepper, nasturtium, egg-plant and leaves and pod of the bean.

On agar plates the colonies are cream-white by reflected light, bluish in transmitted light, thin circular, rapid-growing, appearing in twenty-four hours. In three days the surrounding agar becomes a yellowish green color.

The organism liquefies gelatin, turns litmus milk-blue, does not grow on Cohn's solution, clouds bouillon in twenty-four hours, and is motile by means of one to three polar flagella. It occurs singly or in chains, the elements being short rods from 2 to 4 μ long and 1 to 1.5 μ wide, when grown in agar two days and stained with Loeffler's stain. It grows best at a temperature of about 28° C. and is not killed when kept at — 2° C. for six days.

From spots produced by inoculation, the organism has been reisolated and the disease reproduced. One hundred per cent. of the inoculations have given positive results. Both young and old tissues are alike susceptible to the disease.

A New Bacterial Disease of Nasturtium: CLARA O. JAMIESON, U. S. Department of Agriculture, Washington, D. C.

In May, 1908, Dr. C. O. Townsend, pathologist in charge of sugar-beet investigations, Department of Agriculture, Washington, D. C., received a few diseased nasturtium leaves from Richmond, Va. The wilted and partly discolored leaves showed water-soaked-looking spots from 3 to 5 mm. in diameter. Investigation proved the disease to be due to a bacterial organism belonging to the genus *Bacterium*. Inoculations of healthy leaves produce small dark, watery areas, and the tissue within them discolors, shrivels and often breaks.

The bacterium is a short rod from 2 to 4 μ in length, occurring singly or in chains. The polar flagella vary from 1 to 3 μ. The organism has moderate vitality on culture media, clouds bouillon in 24 hours and grows rapidly on agar, appearing on poured plates as small round, bluish-

white colonies. The bacterium liquefies gelatin, gives an alkaline reaction in litmus milk and produces no gas in fermentation tubes containing peptone-water and 1 per cent. solutions of diffused sugars.

The organism is not killed when kept at a temperature of —2° C. for six days. It grows best on agar at about 25° C., and its thermal death point, found by exposing ten minutes in nutrient solution, is between 49° C. and 50° C.

The bacterium is pathogenic on the leaves of sweet pea, lettuce, pepper and sugar-beet and on the leaves and pods of the bean.

Decay of Potatoes Due to Rhizopus nigricans: W. A. Orton, U. S. Department of Agriculture, Washington, D. C.

A study has been made by the Bureau of Plant Industry of potato diseases in the peat lands of San Joaquin County, Cal.

The most prevalent form of decay is a rapid soft rot, caused by *Rhizopus nigricans* Ehrdt. This is characterized by a dull-brown discoloration of the outer skin and a slight brown discoloration of the flesh, which when cut open soon oxidizes to a reddish-brown. The tissue becomes soft, owing to a solution of the cell walls, and on squeezing there is liberated an abundance of clear brown liquid. This feature has given the disease the local name of "leak" or "melters." There is no bad odor until the invasion of secondary saprophytes.

The large, hyaline, non-septate hyphæ of the fungus are abundant in the tissue. No other organism occurs in the typical "leak." Pure cultures are readily obtained, and a similar decay may be produced by inoculation of sterile raw potatoes under suitable conditions of temperature and moisture. Differences were observed in the rate of decay produced by *Rhizopus* from different sources, that from potatoes producing decay in potatoes sooner than a culture from bread.

Rhizopus nigricans is a wound parasite, capable of affecting potatoes only through abrasions of the epidermis. It appears to spread most rapidly during the "sweat" following the digging of early potatoes in warm weather and gives no trouble after frost comes.

The same fungus causes a destructive rot of sweet potatoes, and will quickly liquefy apples and pears. *Rhizopus necans* Mass., a related species, causes a decay of lily bulbs in Japan.

Some Devices to Facilitate Work in Plant Pathology: E. Mead Wilcox, University of Nebraska, Lincoln, Nebraska.

The method recommended in this paper is, in brief, to arrange all of the material used in pathology work according to one method. It has been found very useful to arrange lantern slides, negatives, index cards, herbarium material and publications alphabetically by the scientific name of the diseased plant, with sub-headings for the several diseases. The herbarium specimens are kept in the ordinary envelopes, which are attached to cards arranged behind guide cards in a vertical file case. The color of the card indicates the part of the plant which is diseased. For example, on the green card would appear specimens of leaf disease, etc. The publications bearing on plant pathology are gathered together and bound by subjects; this necessitates in many cases the partial destruction of a larger publication containing articles on several subjects, but the result is a compact mass of literature on one subject.

The following papers were read by title:

The Spraying of Cedars for "Cedar Apples": F. D. Heald, University of Texas, Austin, Tex.

A Fusarium Disease of the Pansy: Frederick A. Wolf, University of Texas, Austin, Tex.

Studies in Sclerotinia; Sclerotinia fructigena (Pers.) Schröt.: J. M. Reade, University of Georgia, Athens, Ga.

Experiments in the Production of an Anthracnose Resistant Clover: S. M. Bain and S. H. Essary, University of Tennessee, Knoxville, Tenn.

Two Interesting Smuts: L. H. Pammel, Iowa Agricultural College, Ames, Ia.

Henry C. Cowles,

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES
SECTION OF BIOLOGY

A regular meeting of the section was held at the American Museum of Natural History, on March 8, 1909. In the absence of the chairman, Professor Bashford Dean presided for the evening. The following papers were read:

Genetic Relations of the Insectivora to other Orders of Mammals: Mr. W. K. Gregory.

The Harpswell Biological Laboratory: Mr. Max Morse.

The speaker showed a series of slides illustrating the Harpswell region and environs. The laboratory was founded by Dr. J. S. Kingsley in 1898 in the little fishing village of South Harpswell, Maine, eighteen miles from Portland. The immediate region is rich in interesting forms of

animal and plant life which are peculiarly adapted to the use of the investigator. The laboratory offers no courses of instruction, being solely for the use of investigators. The old Tide-mill collecting ground and samples of some of the more important animals and plants to be found there, were illustrated. The geology of the Harpswell region has not been worked up and this presents interesting questions, especially in glacial geology. The speaker pointed out the advantages offered by the laboratory over those of our other marine stations.

Early Developmental Stages in Recent and Fossil Corals: Professor A. W. GRABAU.

Paleozoic corals show in their septal development a fundamental tetrameral plan. This is persistent in the earliest known forms, but becomes masked in later species by the secondary assumption of radiality. The development of mesenteries of modern Hexacoralla shows a similar order of appearance. Pairs of mesenteries develop in succession in bilateral disposition. From the position of the muscle strands they are either *dorsads* (musculature turned dorsal-ward) or *ventrads*. The first and second pairs are ventrads. The third (ventral directive) is a pair of dorsads, the fourth (dorsal directive) a pair of ventrads. The fifth and sixth pairs are dorsads forming with the first and second pairs four false pairs of "braces." After that the mesenteries appear in compound pairs, a pair of dorsads and one of ventrads appearing simultaneously. Thus in the corresponding inter-mesenterial spaces a *brace* of new mesenteries appears, the order being comparable even in detail to the order of appearance of the septa in the Paleozoic Tetracoralla.

A REGULAR meeting of the section was held at the American Museum of Natural History, on April 12, 1909. In the absence of Mr. Frank M. Chapman, chairman of the section, Professor Chas. L. Bristol presided. The following papers were read:

Final Report on the Exploration of the Fayûm in 1907: Professor HENRY F. OSBORN.

In the absence of Professor Osborn, this report was given by Mr. Walter Granger, of the American Museum of Natural History. The speaker stated that the collection obtained by the expedition has been prepared and proves to contain representatives of nearly all of the mammalian forms known from this region, together with several new genera and many species. Among the new forms are rodents, recorded for the first time from these beds, and two peculiar small forms of uncertain ordinal positions. The collection contains many fine specimens of described species which add much to the previous knowledge of these interesting mammals. Doubt was expressed as to the relationships of the genus *Megalohyrax* to the Hyracoidea and *Mæritherium* to the Proboscidia. The speaker stated that the collection of 1907 is being increased through the efforts of a representative maintained in the Fayûm.

By chart and slides the geology of the region was illustrated, also the important topographic features and the method employed in prospecting and collecting the fossils.

Studies on Tissue Growth: Dr. CHAS. R. STOCKARD.

The Partulas of the Society Islands and the Problem of Isolation: Professor HENRY E. CRAMPTON.

The speaker presented some of the general results obtained during investigations in 1906, 1907 and 1908, dealing with the variations and distribution of terrestrial snails of the genus *Partula*, inhabiting the Society Islands. The geographical and physiographical conditions were described. The islands of this group are volcanic peaks of a partially submerged range; these peaks occur sometimes in contact, as in the double island of Tahiti, while others have greater or lesser distances between them. It is, therefore, possible to correlate the specific differences between the snails of different cones with the geographical proximity of the cones. As each island peak is furrowed more or less regularly by valleys and as the snails occur only in the moist bottomlands of these valleys, it is possible to correlate the degree of resemblance between the species of neighboring valleys with the degree of geographical isolation. In brief, such correlations are extraordinarily close, as in the case of the classic Achatinellidæ of the Hawaiian Islands described by Gulick.

The varieties of snails growing in different valleys of one and the same island, or in different islands of the group, can not be regarded as produced in different environmental circumstances. Several illustrations were given which established this conclusion. The phenomena of mutation were observed in several islands. Finally the rôle of natural selection was determined to be a much restricted one in the case of these snails.

L. HUSSAKOF,
Secretary

AMERICAN MUSEUM OF
NATURAL HISTORY

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

The 183d meeting of the society was held in Chemistry Hall, Tuesday, April 1909, at 7:30 P.M. The following papers were presented:

"The Linear Classification of the Cubic Surface," by Professor Archibald Henderson.

"Trichlorethylidenediphenamine Compounds," by Professor Alvin S. Wheeler.

Alvin S. Wheeler,
Recording Secretary

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION

The ninety-second regular meeting of the section was held at the Twentieth Century Club, Boston, on April 8. Professor W. D. Bancroft, of Cornell University, addressed the section upon "The Reversal of the Photographic Image." The speaker advanced a new theory to account for the appearance of a positive and of a second negative upon the development of over-exposed photographic plates, and showed how, by the aid of this theory, many obscure phenomena connected with reversal are capable of a simple explanation. Dr. H. W. Morse, of Harvard University, addressed the section upon "Some New Methods of Nitric Acid Manufacture." After describing the method of synthesis used in Norway, the speaker discussed in detail the "Ostwald Process" for the oxidation of ammonia to nitric acid by the air with platinum foil as the catalyzer.

Kenneth L. Mark,
Secretary

THE SCIENTIFIC SOCIETY OF NORTH DAKOTA

In October of last year a general scientific society was organized with headquarters at the North Dakota Agricultural College and Experiment Station. Administration officers are as follows:

President—J. H. Shepperd, dean of agriculture.

First Vice-president—Linwood A. Brown, professor of pharmacy.

Second Vice-president—H. L. Bolley, professor of biology.

Secretary—Roe E. Remington, instructor in food chemistry.

The society meets fortnightly, and the following papers have been presented:

October 7—"Fixation of Nitrogen," Roe E. Remington.

October 21—"Weed Eradication by Means of Chemical Sprays," H. L. Bolley.

November 4—"The Geology of the Stump Lake Region," D. E. Willard.

November 18—"The Relation of some Recently Formulated Biological Principles to Plant Breeding," O. O. Churchill.

December 2—"Some Engineering Problems Connected with Water Filtration," R. H. Slocum.

December 16—"The Sanitary and Bacteriological Purification of Water," T. D. Beckwith.

January 13—"Some New Productions in Plant Life," J. H. Shepperd.

January 27—"Denatured Alcohol, Manufacture and Uses," Grant J. Morton.

February 10—"Darwin and after Darwin," C. B. Waldron.

February 24—"Birds of North Dakota," W. B. Bell.

March 10—"Studies on Soil Toxins," J. W. Ince.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

A special meeting of the society was held on Tuesday, April 27, 1909, President Fewkes in the chair. The program consisted of a paper by Miss Frances Densmore entitled "The Study of Indian Music" based upon her own recent investigations among the Chippewa of Minnesota. She stated that the object of this study was to find by analysis what constitutes Indian song and musical performance and to make the results of the study available and clear to those who are not musicians but who are interested in the genuine progress of science. Her method of procedure is to make phonograph records of Indian songs, transcribe these, analyze both record and transcription, and tabulate the analyses in accordance with a definite system. Among the interesting results of this work Miss Densmore mentioned the fact that some songs were found to be melodic and some to be harmonic in structure, and also that the rhythm was most peculiar in songs intended to exert a mental influence such as "medicine" songs, certain Mide songs, and also songs intended to incite to war. The paper was illustrated by means of phonograph records and vocal selections to the accompaniment of a drum and the piano. An interesting discussion followed.

John R. Swanton,
Secretary